The Science Teacher

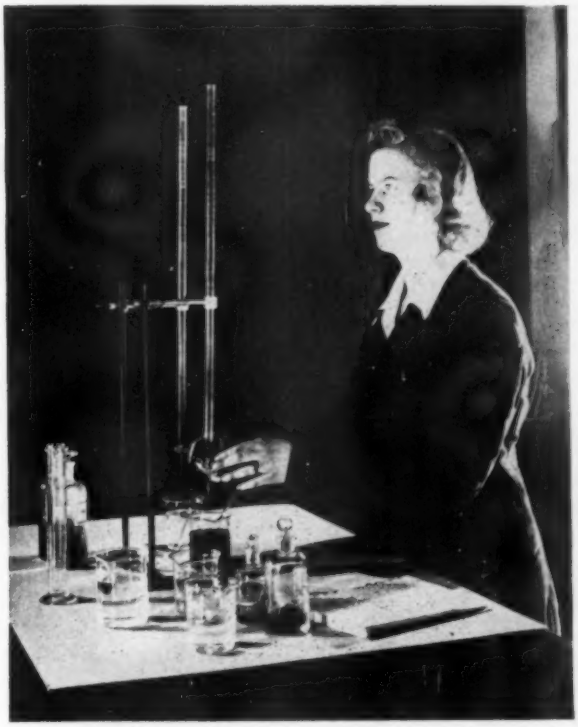
OCTOBER

1943

Volume X

Number 3

Published
OCTOBER
DECEMBER
FEBRUARY
APRIL



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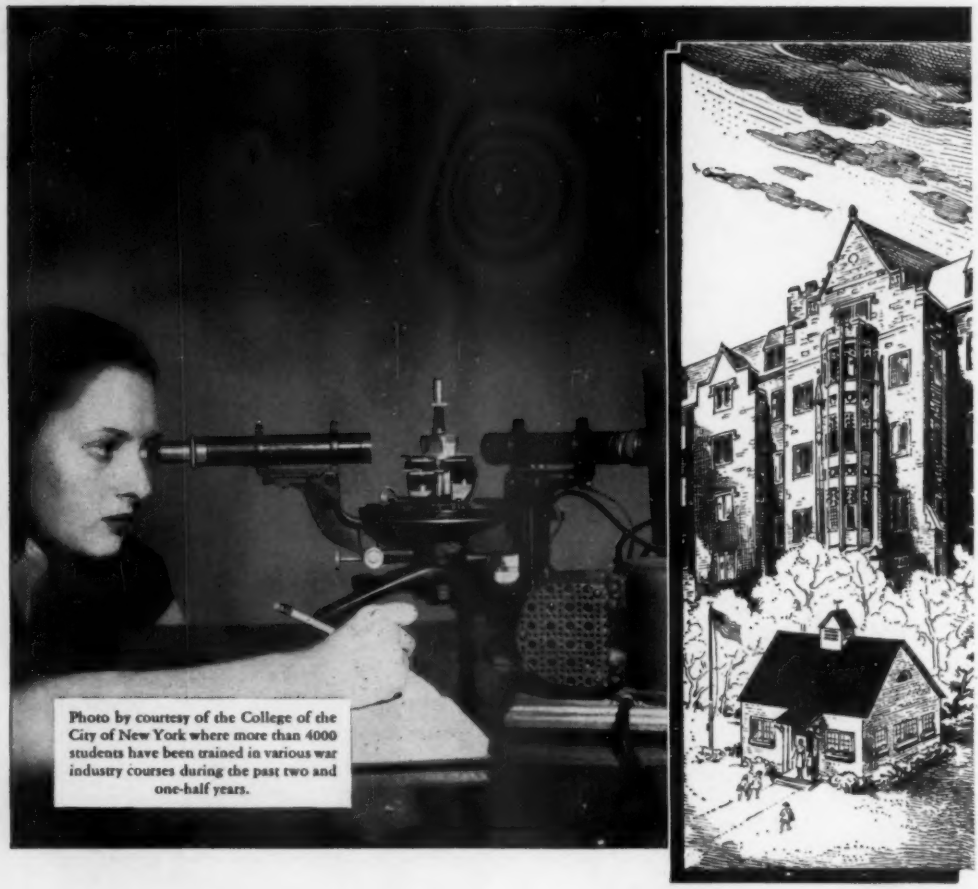
IN THIS ISSUE . . .

A National Service Journal



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A Department of the National Education Association

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The Science Teacher

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A Service Journal for National, State and Regional Associations

Official Journal of

Illinois Association of Chemistry Teachers
Illinois Biology Teachers Association
Indiana High School Chemistry Teachers Association
Iowa Association of Science Teachers, Inc.
Texas Science Teachers Association

Entered as second-class matter January 30, 1940, at the post office at Normal, Illinois, under the Act of March 3, 1879.

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The Science Teacher

VOLUME X OCTOBER, 1943 NUMBER 3

The Use of Sulfa Drugs in Medicine and Surgery

WILLIAM S. HOFFMAN*

Chicago Medical School Chicago, Illinois

Historical Survey

THOUGH the story of the sulfa drugs is less than ten years old, some phases of its beginning are already shrouded in mystery and even in legend. The basic compound of all the sulfa drugs, p-aminobenzene sulfonamide, now known as sulfanilamide, was first synthesized in 1908 in the laboratories of the I. G. Dye Company of Germany, but its medical value was not recognized until 1935. It had been used merely as an intermediate in the development of azo dyes. However, the medical scientists of the I. G. had for some time been investigating the bacteriocidal properties of such dyes, on the suggestion of Ehrlich that dyes adsorbed to protein fabrics like wool and silk would also probably be adsorbed to the proteins of bacteria and therefore be bacteriocidal. Several azo dyes had already been used in medicine, but none of these had any remarkable therapeutic properties. However, in 1932, the compound named prontosil (See Fig. 1) came under investigation. Preliminary experiments showed its value in preventing or curing streptococcal infections in mice, and the compound was quietly placed in the hands of some fifteen German physicians for clinical trial. In February, 1935, Domagk, the director of the Institute of Experimental Pathology of the I. G. published the results of his findings. Shortly thereafter, he announced similarly successful results with a new water-soluble compound called neo-prontosil, which medical world had no difficulty in recognizing like prontosil was an azo derivative of sulfanilamide (see Fig. 1).

German physicians had already had the opportunity of evaluating these drugs, so that at the moment of Domagk's publication, the the correctness and significance of these findings. Indeed, among the first to corroborate the results of Domagk were the investigators at the Pasteur Institute in Paris, under the brilliant direction of Fourneau. He and his colleagues soon made the fundamental discovery that the azo dye was not the real chemotherapeutic agent, but that it was reduced in the body to sulfanilamide, and that it was the latter which possessed the antibacterial activity. This discovery not only destroyed the premise on which the original studies had been carried out, but also made possible extensive experimental investigations, since in the case of sulfanilamide there were no shackling patents to interfere with its use.

CLINICAL confirmation of Domagk's work was reported in England early in 1936 by Colebrook and Kenny in the treatment of childbed fever. Other investigators in England confirmed the findings of Fourneau and extended the usefulness of the sulfanilamide to the treatment of infections by organisms other than streptococci. In America, recognition of the new field did not come until late in 1936, when the confirmatory work of Long and Bliss, of Mellon, and of others appeared. Once awakened, the American medical investigators have swarmed into this field of research from

* William S. Hoffman, Ph. D., M. D., is Professor of Physiological Chemistry and Associate Professor of Medicine in the Chicago Medical School, Chicago, Illinois.

every angle, and have almost monopolized it. An unfortunate accident marred the progress of the use of sulfanilamide in America. A hastily prepared elixir of sulfanilamide, marketed without proper preliminary pharmacological investigation, resulted in a number of deaths, which were finally traced not to sulfanilamide but to diethylene glycol which was used as a solvent for the poorly soluble sulfanilamide.

SULFANILAMIDE, though quite effective in the treatment of streptococcal infections, had only limited usefulness in other infections, particularly pneumococcal or gonococcal infections. Besides, toxic reactions were quite common. Investigations were therefore soon launched to find derivatives of sulfanilamide which had wider usefulness and were less toxic. In 1938, Whitby in England announced the synthesis of a pyridine derivative called M. and B 693, but known in America as sulfapyridine (see Fig. 1). This compound was found to be quite effective in pneumococcal pneumonia and in gonorrhea. In 1939, Fosbinder and Walter in America, introduced sulfathiazole, (see Fig. 1) which was found to be as effective as sulfapyridine in pneumococcal infections, and gonococcal infections and much more effective in staphylococcal infections. Besides, it was less toxic. In the following year, sulfadiazine was synthesized and was shown to be as widely useful as sulfathiazole with even less tendency to cause toxic side reactions. Many other sulfanilamide derivatives have been made and studied, but none are so extensively used as those mentioned, except for special purposes. Among these are sulfaguanidine and succinyl-sulfathiazole (sulfasuxidine), used in gastro-intestinal infections because of their limited absorption from the intestinal tract, and sulfacetimide, for genito-urinary infections. This whole class of drugs is spoken of as sulfonamide or sulfa compounds. Some of their formulae are shown in Fig. 1.

Clinical Use

THE SULFA drugs are for the most part sparingly soluble in water, the solubility ranging from 1 part in 125 for sulfanilamide to 1 part in 8000 for sulfadiazine at room temperature. In spite of this limited solubility, the compounds, taken in tablet form by mouth, are well absorbed from the intestinal tract and are quickly distributed to all of the body fluids in a uniform concentration. There is no accumulation in any particular organ or tissue, and unless repeated doses are given, the drug rapidly disappears from the body by excretion through the kidney. There is no appreciable destruction of these compounds in the body. An abortive detoxication occurs by conversion of a portion of the injected drug to the acetyl derivative, which has no therapeutic value, and which is less soluble than the free compound and may be precipitated in crystalline form in the kidney.

In the treatment of disease, the drug is given whenever possible orally in tablet form. The usual dose for adults is one gram every four to six hours for the first few days, with diminishing doses after the fever has subsided. In children, the dosage is obviously smaller, but in proportion to the surface area rather than to size, for the rate of excretion shows the same proportionality. In any case, the amount given is designed to produce a constant therapeutic concentration in the blood stream, of 8 to 12 mg. per 100 cc of blood for sulfanilamide, and of 5 to 8 for sulfapyridine, sulfathiazole and sulfadiazine. Lower concentrations are not likely to be effective, and higher concentrations tend to produce toxic reactions. This method of determining dosage was introduced by Marshall, who at the same time offered a simple laboratory procedure for the determination of blood sulfanilamide concentration, which is now utilized in most clinical laboratories. This new type of laboratory control of dosage has been extended now to other drugs, notably to salicylates, bromides and thiocyanates.

OFTEN the patient is too ill to be able to take the sulfa drug by mouth. It must then be give neither subcutaneously or intravenously. The latter is the preferable procedure. Sulfanilamide is soluble enough to be given in physiological salt solution, and since such patients usually need the salt

solution as well, the procedure is doubly effective; but when other sulfa drugs are to be used, too much fluid would be required for the introduction of a sufficient amount of the drug. For this reason, the sodium salts of these compounds have been made available and can be given intravenously by the so-called "drip" method, in which the rate of infusion is extremely slow.

In the last two years, solutions and ointments of the sulfa drugs for local application, especially of sulfathiazole, have been made available. These have been used in the treatmnt of wounds, burns, skin infections, and for application to nasal passages, sinuses and ears.

Diseases Treated

THE SULFA drugs have been successful in the treatment of most infections caused by ß-hemolytic streptococcus. These diseases include the various respiratory infections such as pharyngitis, laryngitis, tonsillitis, middle ear infection, mastoiditis, bronchitis, and bronchopneumona. Also involved are puerperal (childbed) fever, erisipelas, peritonitis, meningitis, septicemia, and the streptococcal complications of other diseases. In all these infections all the common sulfa drugs are effective, though the one most popularly used is sulfathiazole, with sulfadiazine gaining in popularity as it becomes better known and cheaper to make.

The pneumococcus infections include lobar pneumonia, meningitis, peritonitis, and conjunctivitis. Here sulfapyridine is most effective, but because toxic reactions especially in the kidney are so frequent, it has been largely replaced in America by sulfathiazole or sulfadiazine. Gonoccal infections of the genito-urinary tract have responded well to treatment with the sulfa drugs, especially with sulfathiazole. The active infections clear up in several days of treatment. However, unless the drug is continued for some time after the relief of symptoms, relapses may occur, which, in the case of this disease, are particularly dangerous from the point of view of public health. Staphylococcal infections have not responded in the ideal manner to sulfa treatment. The best results have been obtained with sulfathiazole. In general, those infections which produced abscesses the walls of which are lined with connective tissue have not been effectively reached by any of the sulfa drugs. Combined local and systemic use of the drugs seems to have produced the best results in these cases.

Gastro-intestinal infections, such as the dysenteries, have now been controlled by the use of sulfa drugs. Here sulfaguanidine and more recently sulfasuxidine have been particularly valuable. Their action is chiefly local, since they are poorly absorbed when taken by mouth.

IN INFECTIONS of the urinary tract, all the common sulfa drugs are effective, including sulfacetimide. The dosage in such infections need not be so high as in other infections, because the site of the infection is along the line of passage of the urine, and the concentration of the drug in the urine may be more than 50 times as great as in the blood or other body fluids.

A number of other infectious diseases are said to respond to sulfa therapy, but the reports are conflicting. Its importance in war medicine is whether sulfa drugs are effective in the treatment of gas bacillus infection, which is so often a complication of war wounds. The earlier reports were quite favorable, but other physicians have reported failures. Similarly, conflicting reports are found in connection with undulant fever. The folowing diseases are completely resistant to sulfa therapy: the virus infections including the common cold, influenza, virus pneumonia, virus meningitis, and the common childhood contagious diseases like chicken pox, mumps and measles. Also the drugs are unsuccessful

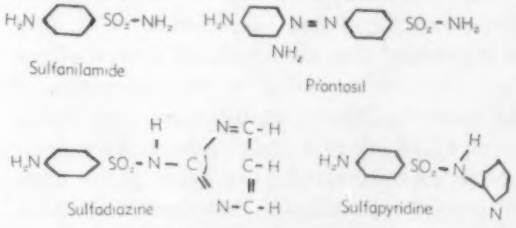

Fig. 1. Formulas of some common sulfa drugs.

Continued on page 30

Editorial and News

Yes, It Can Still Be Done

CAN OUR state and regional associations of science teachers still operate successfully? We hear explanations of difficulties and reasons for a slow down of activity on the part of some groups. And it is true there are substantial obstacles, such as transportation and the securing of suitable talent; but are these obstacles sufficient to prevent us from working in this field? We cannot afford to quit when the going gets tough. Our soldiers did not quit on the Salerno beach head. They stuck, overcame their handicap as resourceful Americans should, and then threw the Nazis out. They had a job to do and they did it.

We science teachers have a job to do and we must do it. Not only do we need to meet our classes, but we have the problem of what is best for them in view of the present and the immediate future. There are weaknesses in the training of youth in science as shown by their performance in the army. Better training in preservation of health is a case in point. Team work is needed in meeting the problem. Our government is asking for cooperation. Association leaders have been called to Washington, D. C. for consultation and for all the help that can be given in working out a satisfactory corrective program for the schools in all science areas. Now it is time for the rank and file of science teachers to make suggestions and through organized effort to get the needed ideas into the class room and translated into functional outcomes of science teaching.

WHEN it comes to active teacher service, it can be readily seen that only active associations can be of any very real service. And so it is urged that all organized groups adjust their plan of operation to the necessities of the present. Many organizations are doing an excellent job of it judging from the reports that we have received. The needs of the present provides a challenge that should stimulate all to succeed.

It might not be amiss to point to a few associations that are functioning well — small as well as large. The Georgia state science teachers' association under the leadership of Mr. McLendon showed a healthy growth last year. They had a program of work and carried it through. The Metropolitan Detroit Science Club, which is more than a city association, also did good work. Here credit goes to their president, Mr. Allen Meyer, who was ably assisted by Mr. Louis Panusch, their editor, and by Mr. Emil Massey, supervisor of science for the Detroit public schools. In the New England states the summer conference was carried out again in 1943, while in New York City the science associations have a regular schedule of work. The program published in this issue for Missouri teachers indicates much activity in that area. Here Mr. Norman R. D. Jones of St. Louis deserves much credit as the leader. In Illinois the Junior Academy of Science last year was more successful than it had been for several years in spite of the fact that it did not hold its annual state meeting and exhibit. Activity was put on a local basis with an increased number of clubs participating. Let us not forget that we are a resourceful people and that we can adjust our methods to the situation in which we find ourselves.

MOREOVER, as individual teachers, let us not mislead ourselves into thinking that we have no responsibility for the success of science teacher work. Instead of dropping out and forgetting to pay our dues, we must remember that each of us is needed to build the local association units stronger, as well as the national group. Each active member can be influential in bringing others into active service. It is association growth on this basis that is most enduring and most satisfactory. So each science teacher should remember that he can be a vital part of our organized efforts for better science teaching and should do his bit.

Council Notes

Edited by NATHAN A. NEAL, Secretary
AMERICAN COUNCIL OF SCIENCE TEACHERS

The 1943 Council Yearbook

EACH year since 1935 the Department of Science Instruction of the National Education Association, or its successor the American Council of Science Teachers has published a yearbook dealing with timely problems of science teaching. An indication of the significance of these publications may be gained by reviewing the titles which follow: *A Continuous Program in Science for the Elementary School, the Junior and Senior High Schools;* (1935) *How Classroom Teachers and Organizations Can Develop Methods and Techniques for Teaching the Objectives of Science;* (1936) *Selecting, Organizing and Teaching Subject Matter for a Continuous Program in Science;* (1937) *Making Science a More Significant Factor in Living;* (1938) *How Science Fulfills the Needs of Boys and Girls;* (1939) *Science Instruction and America's Problems;* (1940) *Making Science Instruction More Worthwhile;* (1941) *Putting Life Values Into Science Education;* (1942).

IN KEEPING with this well established practice of publishing yearbooks which are of practical use to classroom teachers the American Council of Science Teachers will publish a 1943 yearbook dealing with *Pre-Induction Training In Science Education.* This issue of the Yearbook will be published as a supplement to the February 1944 issue of The Science Teacher. The 1943 Yearbook Committee is made up of Dr. Morris Meister, High School Science, New York, N.Y.; Dr. Paul Kambly, University of Iowa, Iowa City, Iowa; and Nathan A. Neal, Board of Education, Cleveland, Ohio, Chairman. The 1943 Yearbook will consist of invited papers by leaders in science Education who have been directly engaged in planning and teaching Pre-Induction materials. It is the hope of the Yearbook Committee that it will also be possible to include voluntary contributions or reports from teachers in the field. These latter might include discussions of difficult problems, proposed solutions for some of the problems of Pre-Induction teaching, or specific techniques or procedures which have proved effective in practice. Any interested teacher reader is hereby invited to correspond with the chairman of any Yearbook Committee member concerning any such written discussion which seems appropriate in term of the theme of the 1943 Yearbook.

Because of limitations on the use of paper and other restrictions the Yearbook Supplement will be limited to thirty-two pages as was the case in 1942. It will be distributed free to all Council members. Membership which includes one year's subscription to The Science Teacher is one dollar. Send memberships or questions concerning membership to Dr. Philip G. Johnson, Fernow Hall, Cornell University, Ithaca, N. Y. Dr. Johnson is Executive Secretary-Treasurer of the American Council of Science Teachers.

★

WESTINGHOUSE Electric and Manufacturing Company, 306 Fourth Avenue, Pittsburgh, Pa., has prepared for distribution to schools a 24" by 37" wall chart on the "Biggest and Littlest Things in the Universe." This chart presents in colors the ranges of 20 measured things from the universe itself to the proton. Yes, it is free of charge. While you are writing you may wish to ask for the booklet "Scientists for Tomorrow" and "Quickfacts about Westinghouse."

★

Have you seen the recent book "Meeting the Mammals," by Victor H. Cahalene. Published by Macmillan, 1943. It sells for $1.75 and presents the mammals of our national parks in sketches and interesting life histories. Get it for the school library.

Some Proposals for a United Front

By Representatives of Science Teachers Organizations

For a more effective training of youth all science teachers are urged to study through this call for cooperative action on the part of all science groups as well as individuals —and then do something about it. Editor.

THE WAR has focused attention on science teaching. Science teachers have been eager to modify instruction to meet the emergency. There have been differences of opinion as to the modifications which were needed, as a result, there has been an undesirable amount of confusion and complacency. This condition is unfortunate and much of it has been the result of hearing and reading about segments of the science needs. Only recently have leaders in the various organizations of science teachers had the opportunity to see the entire area of needs and to assist in meeting these needs.

Several leaders from organizations involving biology teachers were called to Washington, D. C. in May for a meeting related to health education. These persons returned for a work period in June. Similarly a group of leaders from among organizations of physical science teachers participated in a work period in Washington, D. C. during the third week of July. At each of these meetings plans for further cooperation were discussed with eagerness and concern. The leaders from among the five organizations involving biological science teachers prepared a series of proposals which they adopted as a statement of their ideas. The leaders from the organizations involving the physical science teachers studied these proposals and likewise adopted them as an expression of their ideas. Thus, the statements given here have been adopted by *leaders* from among eight organizations of science teachers. This statement of proposals is being printed in all the magazines of these organizations and the judgments of all members are desired. Kindly communicate your ideas regarding these proposals and how they may be carried out to the executive officer of any one of the following organizations.

National Association of Biology Teachers—M. A. Russell, President, 403 California Ave., Royal Oak, Mich.

American Science Teachers Association — Morris Meister, President, 184th Street and Creston Ave., New York, New York

American Council of Science Teachers — Norman Jones, President, 5073a Mardel (9) St. Louis, Missouri

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The American Association of Physics Teachers, Lloyd W. Taylor, President, Oberlin College, Oberlin, Ohio

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National Association for Reserach in Science Teaching — Hanor A. Webb, George Peabody College for Teachers, Nashville, Tennesee.

National Council on Elementary Science — Florence Billig, Wayne University, Detroit, Michigan.

Reports of Resolutions Committee

Assumptions:

I. "We have one great task before us. That is to win the war. At the same time it is perfectly clear that it will be futile to win the war unless during its winning we lay the foundation for the kind of peace and readjustment that will guarantee the preservation of those aspects of American life for which the war is fought."

In this statement to the Association of American Colleges, President Roosevelt defined the dual function of the Nation's efforts in the war and outlined the positive role of American education.

The science teacher's responsibility in this dual role is exceptionally large. First he recognizes the importance of his field in the successful prosecution of this machine age war, for he realized that the training he provides in essential fields may ultimately play a large part in winning the war. Second the science teacher is increasingly accepting responsibility in helping to provide an informed intelligence on the problems leading up to the war and the task of advancing the causes of freedom and security in the post-war world.

II. The nature of the war emergency and the peace problems which we will face demands a rethinking and continuous evaluation of science teaching. This is a technological war. It is being fought in laboratories, on testing grounds, and production lines, as well as on fighting fronts. An early, successful, and conclusive termination of the war depends largely upon the extent to which specialized implements of war can be designed and produced by the allied nations and thrown into battle by trained allied manpower. From drafting boards to front line action, this war is being fought by specialists. The great majority of men inducted into the Army today are assigned to duties requiring specialized training. Practical and functional knowledge and skills in science are fundamental to this training, as they are in almost every essential service to the nation at war.

The problem of the pre-induction training best designed to fit young men for armed duties is complex. The answers to the problem have been obscure and ambiguous. They can never be final or clothed in ultimate detail. But clarification of the answer is possible and the need for it is urgent. It can finally be made only by the teachers on whose shoulders rest the responsibility for effective training.

Similarly the successful attack by science teaching on the many persistent personal problems faced by young people and the social problems amenable to scientific treatment depends upon the critical analysis and leadership given by science teachers. This analysis and leadership must immediately be increased.

Resolutions:

I. The present problems of science teaching are sufficiently important and urgent to merit the concerted attention of all leaders in science education. The American Council of Science Teachers should, therefore, cooperate with other science teacher organizations as fully as possible in the attack on wartime problems of science teaching. It is recommended that the ACST stimulate the formation of a wartime council with representatives from the national and regional associations as an effective means of attack on these problems.

II. Many, and sometimes contradictory, reports have been made on the needs of the armed forces for pre-induction training in the area of science. The ACST singly, and in cooperation with representatives of the other national and regional science teacher associations, should critically explore the needs of the armed forces, and should prepare such reports and other materials as may be needed for the effective meeting of miiltary manpower needs through pre-induction training.

III. Non-Military wartime needs should critically be explored through contacts with governmental and civilian agencies and proposals and other materials as may be needed should be prepared to meet these needs through science instruction.

IV. There are real dangers that purely wartime training needs may unnecessarily de-

Continued on page 36

Army Does Not Dictate Science Program of Schools

NORMAN R. D. JONES
President, American Council of Science Teachers

THE EDUCATIONAL preparation of our youth has been found inadequate for several branches of the Armed Forces. The specialized sciences and mathematics had been by-passed by many students for the so-called snap courses. In an attempt to remedy this deficiency, refresher courses were organized. The War Department established the Pre-Induction Training Branch to study the "needs" of the men in the Armed Forces. Courses were outlined for the 16 and 17 year olds in the areas of Machines, Electricity, Shop, Radio and Radio Code. The purpose of such courses was to give the potential inductee that background of preparation which would make possible more satisfactory results to both the inductee and the nation in the time available for military training.

Upon looking over the suggestions for material to be covered in the pre-induction courses, many educators said immediately that the War Department was trying to dictate to the schools as to what they should teach. This is an unfounded rumor which should not be harbored or repeated. The writer had the privilege of assisting in the preparation of one of these courses, so from "first-hand information" can say that there was no attempt on the part of the War Department to dictate what should be taught or how it should be done.

AT THE various conferences attended the "needs" of the inductee were pointed out by members of the Pre-Induction Training Branch of the War Department. Incidentally, these members were school men during peace time and several of them were science teachers. When an attempt was made to find out what they desired the schools to do, a firm but polite reply came that that was the problem of those brought in for these conferences. Consequently it was neccssary for those present to go to work and plan the instructional aids to meet these "needs." Materials and analyses were made available but not a sign of "Army Dictation."

Thus, let it be said that the pre-induction courses for the various fields have been written and are being revised by representatives of the teaching profession, without "dictation" on the part of the authorities of the War Department. You can have a part in the development of science courses to meet military needs. Are you interested in such work?

The Washington Conferences

THE REPRESENTATIVES of five National Associations of teachers, namely, the sciences, physical education and health, mathematics, English and social sciences, met on Saturday, April 24th in Washington, D. C., with members of the staff of the U. S. Office of Education and Consultants in the several fields in the Pre-Induction Training Branch of the War Department.

This meeting was called to discuss pre-induction needs in these curricular areas as found by War Department Consultants and to discuss ways and means whereby materials might be prepared and distributed to assist schools and teachers in implementing pre-induction needs. It was decided that the best approach in solving the needs shown would be to invite small consultive committees to Washington in each of these fields.

SCIENCE representatives met at the U. S. Office of Education on May 19 and 20, primarily to review and consider the usage of the manual, *Physical Fitness Through Health Education*. Those attending this conference were: Dr. John Lund and Dr. Ruth Grout of the U. S. Office of Education; Dr. Will Burnett of the Pre-Induction Training Branch of the War Department; Lela Massey, New York Home Economics Association; Ira C. Davis, Central Association of Science and Mathematics Teachers; Paul F. Brantwein, New York Association of Biology Teachers; Norman R. D. Jones, American Council of Science Teachers; Elizabeth McHose, Physi-

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Apparatus For Demonstrating An Application of Linear Expansion in High School Physics

M. J. W. PHILLIPS

West Allis High School West Allis, Wisconsin

THE FACT that different solids expand at different rates, that is, that different solids have different coefficients of linear expansion is made use of in various ways. For example in the compensated clock pendulum this principle is employed for maintaining the length of the pendulum constant.

This principle is easily demonstrated by means of simply made appartus as illustrated in Fig. 1. The essential parts are two pieces of glass tubing 45 inches long, and one piece of tin or zinc tubing 36 inches long. Tin tubing can be obtained from old soda fountain fixtures or bar fixtures. Zinc tubing is not so easily obtained but lead tubing could be used since lead and zinc both have a coefficient of expansion of .000029. The coefficient of expansion of tin is .000022, hence a slightly longer piece of tin is necessary than of the two other metals. The glass tubes are connected to the tin tube by short pices of rubber tubing. The system of tubes thus connected is then fastened to a board 4½ feet long by 6 inches wide, along the lower edge is placed a strip, ½-inch wide to serve as a supporting shelf along which the lower glass tube can be free to move. The whole board is supported edgewise by two ½-inch dowels 5 inches long fastened into a base board, 15 inches by 5 inches, making it a permanent piece of equipment.

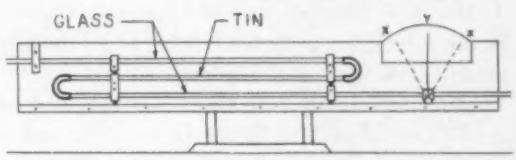

Fig. 2. Arrangement of Apparatus showing linear expansion.

THE UPPER glass tube is securely fastened by two screws and a strip of wood to the upper left hand corner of the back board. This tube is then securely clamped to the tin tube at the right of each. Near the left end of the tin tube, the lower glass tube is securely clamped in a similar manner. Make certain that the tubes are securely clamped together in the manner shown in order that the total expansion of the two glass tubes will be toward the right while the total expansion of the tin tube will be toward the left. Small blocks are fastened to the upper and lower glass tubes to keep the three tubes

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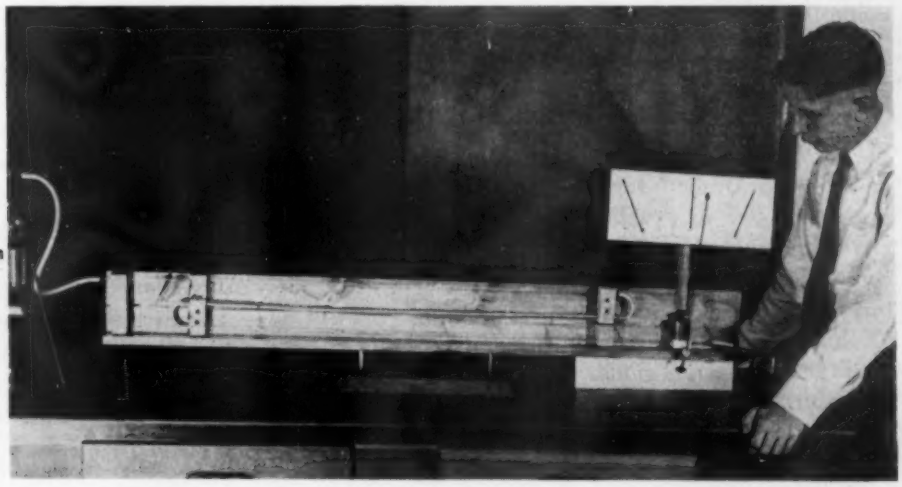

Fig. 1. Demonstrating a practical application of linear expansion.

Pre-Induction Radio

WILLIAM STOCKING, JR.

Cooley High School Detroit, Michigan

THE PRE-INDUCTION radio courses can be the most interesting and enjoyable courses in the school for both the teachers and the students. Teachers and students should let the "radio bug" really bite them because interest is such an important factor in learning radio. In this way, teachers and pupils will learn from each other.

In any large school there are boys who have had some experience in constructing and operating radio equipment. These boys almost automatically become "A" radio students, and can be of great assistance to the teacher in constructing equipment and in helping less experienced pupils. At Cooley High School there are twin brothers with amateur radio operator's licenses. Last semester each of the twins spent two periods a day giving individual code instruction to other boys. This semester some of these other boys are in the code class and are giving help to the slower learners.

It has become traditional in the Cooley radio classes for the "A" students to erase the blackboards at the teacher's request. These "board erasers" are often asked questions by other members of the class. Quite often arguments develop as to how various circuits work. These arguments are usually brought to the instructor for settlement and are frequently made the basis for general class discussion.

THE RADIO code class has progressed to the point where there are three groups, the slow, the medium, and the fast. The slow group listens to a code-practice oscillator keyed by one of the faster students. The medium group gets its practice from phonograph records; while the fast group uses another code practice oscillator keyed by the instructor. On some days instruction in sending is given. Each of the three code-practice oscillators has a different pitch. At times all three oscillators are used at the same time. Pupils soon learn to listen to one pitch only and thus practice in "copying through interference" is obtained. The slow group often listens to its code through earphones which help to cut out interfering noises.

Construction and operation of home-made equipment is a vital part of learning radio. This experience gives real meaning to the theory studied in the classroom. Most of the "board erasers" and many other students have constructed, or are constructing receivers at home. Some have constructed small transmitters, code practice oscillators, or audio-frequency amplifiers. The construction of radio equipment is excellent experience for a teacher because it helps to develop a "radio instinct" which saves much time. The Cooley radio instructor spends his three "free" periods each day in a basement room working with students who have the same periods "free." Most of the time is spent building equipment, helping students construct or repair radios, and answering students' questions. The basement room has a table and a cupboard in which tools, parts, and equipment can be locked.

A LARGE department store donated seventeen obsolete radios from which parts are being salvaged. Useful equipment is being constructed from the parts thus obtained. Because parts specified in plans already drawn up are hard to obtain, the plans and diagrams are made to fit the parts on hand. Students get a big kick out of helping the teacher draw up the plans and offer excellent suggestions. One student suggested trying a variable condenser as a pitch control on a code practice audio-frequency oscillator. The instructor did not think it would work. However, the idea was tried, and the pitch control provided by the variable condenser was excellent.

Among the first things salvaged from the old receivers were power supplies. These power supplies are used to run receivers, code practice oscillators, and demonstration equipment.

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Physics and War*

A. F. IOFFE**

Institute of Physics and Technology — Leningrad, Russia

IN THE Soviet Union we are not concerned with questions of competition between physics and chemistry nor with questions of the advantages accruing to this organization or that. There is a friendly, unified collaboration of the scientists of the whole Soviet Union. In particular, the Academy of Sciences mobilizes all its members and collaborators, and the great mass of scientific workers in institutes outside of the Academy, for the solution of the diverse problems which arise from the needs of the present war.

It may be confidently said that in the matter of scientific and technical work for defense, the Soviet intelligentsia has shown itself to be of such stature as should have been expected in our land. We did not require the foundation of any new, hastily constructed institutions in order to plan and mobilize science. The organization of scientific work in the Soviet Union had been running in a planned channel for a long time. The advanced science and the advanced institutions of the Soviet Union are directed always and essentially into the service of the country and of humanity in general. Therefore, Soviet science has for a long time yielded profits both in industry and agriculture, and in problems of defense. Our government and Comrade Stalin have continually warned us that we were in a situation in which an attack was inevitable, and that consequently we had to prepare and mobilize all our forces in advance. Long before the war this sage foresight was coupled with a deliberately planned, scientific organization of work. There was a direct connection between each scientific project and its application. Compared to the situation abroad, the organization in the U.S.S.R. is a model which the most advanced nations can only dream of. As a result, to the surprise of many, not only of our enemies, but also of our friends abroad, the technical power of our army was vastly higher, and the basic arms of war — our tanks and airplanes — were much better than might have been assumed. It has turned out that our weapons are at a higher level than those produced by German military technique.

IN THE field of physics the Academy of Sciences has four physical institutes, excellently equipped and with outstanding scientists. In addition, we have one of the mightiest institutes of physics, specializing in the field of optics — the Government Optical Institute. There are also the physical institutes of the Moscow and Leningrad Universities. These physical institutes are now completely mobilized for defense problems. Even in the very first days of the war, all of this activity was directed toward the war, and they soon found means of maximizing their efficiency.

Soviet physicists, workers of the Academy of Sciences, keep in close connection with military institutions, especially with those at the front, and continually observe the performance of our installations under real war conditions. Whereas formerly we used to have an

* Address before the general sessions of the Academy of Sciences of the U.S.S.R., in 1942; abridged from translation by Dr. Henry F. Mins, Jr. Permission to publish this address has been granted by the editors of *Science & Society*, a quarterly magazine published from 30 East 20 Street, New York.

** Academician Ioffe, Director of the Institute of Physics and Technology at Leningrad, is one of the most prominent physicists in the U.S.S.R. In April, 1942, he received the Stalin prize for his work on semi-conductors. He is also well known abroad, having been a Soviet delegate to congresses of physicists in Paris, Brussels and London, and having lectured at the University of California, Berkeley.

interval between the laboratory solution of a problem and its practical application, which at best amounted to three years but in general was of the order of five years, recently means have been found to hasten the process. Problems studied today find immediate application to the present war being waged by all our people.

MANY of our projects are being carried out, not in laboratories, where we formerly concentrated all our activity, but in factories where various models are constructed, or where our new methods are applied, methods which are intended to help in the defense of our land; and sometimes our labors are carried out directly under military conditions. One such project, relating to the Navy, was carried out by the Physical-Technical Institute. At the present time, all its collaborators, with very few exceptions, are working, not in laboratories but on warships in the White Sea, in the Northern, Baltic, Caspian Seas, and in the Far East. Many of the collaborators have to carry on their work while taking part in warlike operations and undergoing all its dangers.

A small group of workers of the Leningrad Physical-Technical Institute remained in Leningrad. It is known what the conditions of life were there throughout all the winter. Although faced with the possibility of fleeing any day, they stayed in Leningrad, carried on and are carrying on today determined and important work which has already yielded great results.

Unfortunately, I cannot mention the most important and interesting tasks of contemporary physics. Naturally, the more important, the more enticing, new and interesting is the given military subject, the less it is open to scrutiny. I cannot go into the details of the truly heroic work which many scientific workers are performing today, under war conditions, but I was a personal witness of how a whole group of co-workers over a period of three weeks did not leave the laboratory, working there day and night. Now and then, collapsing, they would sleep right there, on the tables, but in those three weeks they finished a tremendous labor in such form that it could be tested. I saw how we worked in Kazan at forty to forty-five below zero in the open, with instruments to which the hand froze and the skin came off. Not one of the collaborators gave up, but carried the work to an end. Such are the methods and tempo of work of Soviet physicists and other scientists under war conditions. These facts exemplify that marvelous patriotic enthusiasm which inspires all our intelligentsia and all our people.

Perhaps the greatest of our problems come directly and indirectly from aviation. In order to render a given object invisible from an airplane, camouflage is used. The object is given such an appearance that from above, from an airplane, it can not be seen. Extensive use is made of observation, not only by visible light (where everything is camouflaged) but by infra-red rays, and photographs are made by infra-red rays. In this way much that for the eye merges with the background stands out in relief. It was necessary to change comouflage itself, to try to camouflage in such a way that the object should not be visible even by infra-red rays.

The struggles against the airplane requires that it be discovered in time and its location determined with sufficient accuracy. Observation is made by both visible and infra-red light and by acoustic listeners.

Use is made of radio apparatuses, which have the obvious advantage that radio waves freely penetrate cloud and mist, do not depend on the wind and are more universal than light and sound waves.

Having determined the direction of the plane, it is necessary to fire on it in time. This is always difficult, since the velocities of planes are always high, and consequently the correlation must be instantaneous, since very little time is left, first to see where the plane is, then to calculate and aim the anti-aircraft fire. There is so little time that a man is not able to carry out all these operations. To remove this difficulty, automatic intermediate apparatus was set up which performs all these operations faster than a man could. Such an apparatus for the operation

of A-A zenith batteries has been described in many newspaper dispatches from England.

Further, aviation sets entirely new demands in the field of heat phenomena. A plane may find itself in the course of a few hours in a temperature of 50 degree above zero (on the ground), and then 50 below in the air. Consequently, all the instruments and attachments on the plane must be so devised that the enormous temperature interval of 100 degrees will not interfere with their operation. If a certain grease flows at 50 degrees above, or is too liquid, it will not satisfy this requirement. On the other hand, if it freezes at low temperatures, it is not suitable for high altitudes where the temperature falls to 50 below.

I shall not enumerate all the numerous questions of physics raised by aviation. Of course, I have mentioned here only a part of what should have been said. In order to pilot a plane, its speed must be known. The earth can not always be seen; it is necessary to have other objects which define the speed and direction of motion. Coordinates must be established, connections obtained with the landing fields and the earth, and directions received as to what to do and how to do it. Communications must be set up between planes. All these diverse questions, which inevitably flow from the work of aviation, set physics a whole series of tasks. The most expedient, the most simple, practical, cheapest solution of each of these problems results in an essential lightening of the work of the plane.

A GREAT number of problems come from communications, which are very important in war time: optical and radio communications, conduction (wire) communications and others. All the possible forms of communications are widely applied and used in war time, and the problems raised are more exacting than in ordinary times. In addition to surface communications, we need submarine communications as well. Yet, under the water, radio waves are dampened so soon that at a distance of several meters their intensity becomes quite imperceptible. Light, although it is propagated in thoroughly clear water, is diffused in sea water and is invisible at small distances. Ultra-violet, infra-red and every other part of the electromagnetic spectrum which we can apply, proves to be unable to fill the needs of submarine communications. The only inpulse that is propagated in water to great distances is elastic and sound vibrations. In the last war the French physicist Langevin — honorary member of our Academy and a great friend of ours — invented and perfected an apparatus for producing an ultra-sound with a frequency of vibration of 100,000 hertz. This apparatus of Langevin, called the echo sounder, determines the depth below the surface with the aid of an ultra-sound ray which is directed down and then reflected; the time required to reach the bottom and back is proportional to the depth. The echo sounder has proved applicable to a whole series of war tasks. The science of ultra-acoustics has been founded, opening up a whole domain of science with various technical applications, and disclosing numerous scientifically interesting properties of short waves. This circumstance served too as a powerful stimulus to the development of acoustics, to the revival of this realm of science. At one time it seemed that acoustics as a science was already completed: everything was calculated, everything was known. The revival of acoustics in the domain of entirely new problems, its quick rise, the appearance of a new set of themes is the result of those problems suggested by war and electrotechnics.

EXTRAORDINARILY important for defense and very interesting for molecular physics and its entire further development is the question of the interaction of the projectile and means of fortification, whether tank armor or bomb-proof, on which bombs fall. This interaction under the enormous velocities attained by projectiles, velocities reaching many hundreds of meters per second, has brought to light a whole series of new properties of matter, which were formerly unknown and therefore received no attention. In particular, it appeared that with great velocities ordinary fluids behave like solid bodies. Under such

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The Importance of Insects in War Times

C. L. METCALF

University of Illinois Urbana, Illinois

This is the fourth installment of the article The Importance of Insects in War Time written by Professor C. L. Metcalf especially for The Science Teacher. The first installment begins with the December, 1942 issue. It will be continued through the February, 1943 issue.—*Editor.*

AS POINTED out previously, most of the damage insects do to us and our interests is directly or indirectly the result of their efforts to secure food. Accordingly, the extent of the damage of different pests is closely correlated with the value of the substances they insist upon having as their food. The most precious food that insects take is human blood. Next in value is the blood of our highly selected and indispensible domestic animals, which suffer in all of the ways that we do, and more severely, because they are not able to protect themselves from the insects' attacks as effectively as we can. In these days, with the value of meats, eggs, wool and hides increasing daily, it behooves all who have any domestic animals to strive as never before to keep them as free as possible from the annoyance and devastating attacks of bevies of lice, flies, fleas, bots, mites, ticks and other parasites, which restrict their growth, fattening, and yield of milk or eggs destroy their fleeces and hides, and often cause their deaths.

Flocks of poultry are almost certain to suffer from swarms of chewing lice, which live among their feathers, crawl over and gnaw away at their skins, keep them from resting, ruin their appetites, cut down egg-production, and often kill young chicks and turkeys. There is such a very efficient remedy for all of the poultry lice, that the wise owner will examine his flocks at intervals throughout the summer, by parting the feathers and looking for the small flattened parasites scurrying away to hide under other feathers and their eggs glued to the feathers, on various parts of the body, especially about the vent and on the heads of young fowls. If any of the lice, from very tiny ones up to one-eighth inch long are found, the entire flock should be treated, because they increase so fast that every fowl on the farm is likely to become infested, in a short time, from a few lousy hens.

A VERY simple and effective control is to dust or dip the fowls with *sodium fluoride*, f-l-u-o-r-i-d-e—a poisonous white powder that can be purchased from most druggists. A pound will be enough to treat a flock of 50 to 100 hens. The best way to use it is to dissolve some soap flakes or laundry soap in warm water, at the rate of one ounce to the gallon of water and then add one ounce of the sodium fluoride to each gallon of soapy water. Fifteen or twenty gallons of the soap, water and fluoride solution should be placed in a small wooden tub or large earthenware jar—not metal—wide enough and deep enough so that the fowls can be dipped into the solution one at a time until all have been treated.

The fowl should be held by the wings with one hand, lowered into the dipping solution and the fathers ruffled with the other hand for about one-half minute, until they are wet to the skin. Then duck the head under twice and the fowl is ready to release. All lice on its body will be dead in a few hours and those which may hatch from eggs present will be killed by the poison on the skin and feathers. If every fowl on the farm is treated, one treatment should give complete eradication. Care must be taken that no animal has a chance to drink the poison liquid and that none of the sodium fluoride is taken into the operator's mouth. If there are scratches or cuts on the hands, they should be protected by rubber gloves.

INSTEAD of the dipping method, the fine sodium fluoride powder, just as it is purchased, may be placed in a large salt-shaker, the fowls held, one at a time over a broad shallow pan and the powder dusted among the feathers on all parts of the body. Large amounts are not needed, but care should be taken to get some of the dust into the feathers on the breast, back, head, wings, legs and

especially around the vent. By saving the powder that sifts down onto the pan, an ounce or two of the sodium fluoride may be made to treat 40 or 50 hens.

The minute eight-legged poultry mites, which live in nearly every poultry house, hiding in cracks during the day time and climbing up the roosts to attack the sleeping fowls at night, sucking their fill of blood and returning to their hiding places before dawn, often take a big toll of egg production and growth of poultry, without the owner realizing that they are present at all; because they are not on the fowls or exposed to view during the day time. Examination of the litter on the floor of the hen house or the lifting of perches or egg-laying boxes from their supports will often reveal hundreds of the gray or red mites of the size of pin heads. They can be eradicated by a very thorough clean-up of the poultry house followed by spraying the floor, walls and cracks with creosote, crude petroleum, anthracene oil or waste crankcase oil mixed with half its volume of kerosene. Spraying should be done in the morning and the fowls kept away until the oil has soaked into the timbers or evaporated.

Poultry lice are most troublesome in summer. Lice on cattle, hogs and horses are most abundant and troublesome in winter when the animal's coat is thicker and less oily. For lice on these mammals, which may be blood-suckers as well as chewers, the simplest effective treatment is to groom the hair of the animal with raw linseed oil—*raw*, not boiled or refined linseed oil. It may be applied to cows, hogs or horses in a stall, just as one would curry a horse, by dipping a stiff-bristled brush in the full-strength linseed oil and brushing the coat on all parts of the body until every hair is lightly moistened with the oil. A quarter of a pint is enough for a cow or horse. It should not be rubbed into the skin should be allowed to cool off for an hour or so too vigorously and the animals should be kept stabled out of the sunlight for a full day after treatment. If the animals are wild and have become excited and overheated, in herding them into the stables for treatment they should be allowed to cool off for an hour or so before applying the linseed oil. An alternate treatment is to rub a pound of extremely fine wettable sulphur powder into the coat of each cow or horse, repeating this treatment two weeks or ten days later; or the use of a good grade, fresh wash or powder containing rotenone.

For the destruction of lice on hogs, crude petroleum applied all over the skin is an excellent control. If there are too many animals to be groomed with a hand brush, the oils may be applied with a spray pump that will deposit a light film of oil on all parts of the body. The oil or sulphur treatments should be repeated two weeks later to destroy any young lice that have hatched from eggs present at the first treatment before they have had time to grow up and lay more eggs, which are not always killed by the oils.

A MENACE to our essential wool crop, and a very great drain on the vitality of sheep everywhere, are the louse-like flies usually called sheep "ticks." They are not ticks at all, but wingless degenerate flies, much more closely related to the house fly than to cattle ticks or other Acarina. Nearly every sheep in untreated herds supports dozens of these blood-sucking parasites, which cause the sheep to rub, gnaw and scratch at the itching bites, spoiling their fleeces and resulting in a loss of several million dollars a year in the wool and mutton crop of America. At a cost of 4 or 5 cents a head, these sheep ticks can be eradicated from any farm by dipping all of the sheep and goats in one of the commercial coal-tar creosote or nicotine dips twice during warm days in early summer or fall, the two dips being given exactly 24 days apart. An investment in this way of 4 or 5 cents a head will almost certainly bring a return of at least five times that amount within the year.

From about January first to May first, owners of cattle should be fighting the ox warbles or cattle grubs, which cause the big tumors, as large as the end of one's thumb, under the skin along the backs of the animals, and ruin the value of the hides of animals that are butchered and the health and milk yield of those which are kept on the farm. By sponging the backs of the animals with a mixture made by dissolving one-quarter pound of soap

in each gallon of water and stirring a pound of fresh, high-grade rotenone powder, such as Derris, Cubé or Timbo into each gallon of the soapy water the maggots can be killed in the backs of the animals, before they escape to the soil to transform to the flies which glue eggs to the animals' hairs for the next generation. The powder used should be a product that is guaranteed to contain 4.5 per cent rotenone. Instead of applying by hand, it may be sprayed over the backs of infested animals, at high pressure so as to wet the coat thoroughly. Since the maggots do not all appear under the skin along the back at the same time, treatments should be started about Christmas time when the first lumps are found, and repeated as new waves of the maggots appear and eat breathing-holes through the hide, in late January, again near the end of February, of March and of April.

THE RELATED bots or maggots that live all winter in the stomachs of horses, devitalizing and sometimes killing them, require a rather technical treatment that should be undertaken only by a trained and experienced veterinarian. A proper dose of carbon disulphide administered by means of a stomach tube or in a gelatine capsule in such manner that it reaches the stomach unbroken, will kill the bots without injury to the horse. To be most effective it must be timed about four weeks after the first killing frost in the fall has destroyed all of the egg-laying flies; and their eggs on the hairs of the horse have been killed by sponging the legs, breast and under jaw of the animals with warm water containing 2 per cent phenol, at a temperature of 118 degrees Fahr., on a day when the air temperature is about 60 degrees.

Livestock owners who purchase any animals from the South or West for fattening, should be on the lookout for maggots of the screwworm fly, which infest wounds of cattle, hogs, sheep and other animals, preventing them from healing, tearing their way deep into the adjacent flesh, causing very painful and often fatal sores. The screwworm fly does not winter in this area, but if introduced in infested animals, it may become established in that community, produce several generations of offspring and cause a severe epidemic until the following winter kills them. If scratches, cuts, sores, the eyes or nasal passages of animals, or the navels of new-born are found to contain whitish maggots, the wounds should be swabbed dry with sterile cotton, then flushed with 90 per cent benzol applied with a syringe; and a plug of cotton soaked with the benzol should be gently inserted into the wound and held in place with adhesive tape, if necessary. The benzol will kill the maggots deep in the sore flesh. Then if necessary acid-free pine tar oil should be applied over the cotton plug and all around the wound and repeated every other day to aid the healing and to keep other flies from laying more eggs upon the skin next to the sore.

If the screwworm flies should become established in your community, it will be of the utmost importance to prevent your live stock from breaking, cutting or tearing their skin in any way. All wounds due to barbed wire, projecting nails and snags that may tear the skin; dog bites; wounds from horned animals or kicking horses should be prevented. Operations such as dehorning, castrating, docking lambs' tails and every thing else that causes a flow of blood should be postponed until cold weather, when the egg-laying flies have been killed off. The screwworm flies are strongly attracted to blood, sores, infected eyes and nostrils to lay their eggs; and, unlike the bot flies, will not lay eggs at all upon healthy, uninjured animals.

THE THIRD great phase of insects' attack and damage, which is especially vital and crucial in war times, is their diversified and universal attack upon all kinds of stored products and possessions, except metals, glass, earthenware and precious stones. Next to our blood and that of our domestic animals, the most valuable food insects take is our highly-processed, manufactured, stored foods, fibers, furniture, books and papers. These pests which feed upon plant and animal products after they have been grown, harvested, and stored and have often been passed through expensive manufacturing processes and incurred addi-

tional expense for packaging, advertising, selling and distributing—such pests have a capacity for costly destruction far in excess of those which feed upon the growing plants. The same amount of food eaten constitutes a much greater loss, just as breakfast cereals or cakes may cost us $10 to $30 a bushel, when the wheat, corn or rice from which they are made is worth only a dollar a bushel. Or a fine table or davenport may cost a hundred dollars, whereas the wood from which it was made could be purchased for $10 to $20. Furthermore, eating a very small quantity or portion of such highly refined products, often results in total loss. A precious photograph or painting may be completely ruined by a silverfish or cockroach that takes a single meal from the image of grandma's nose or your sweetheart's beautifully photographed eyes. When we find a worm in a candy bar, a few weevils in a sack of flour, or some cigarette beetles in a package of tobacco, we are likely to throw away the entire package. And a clothes moth that takes a single meal from a conspicuous place on a man's dress-suit, a lady's fur coat, or the upholstery of a valuable chair, has frequently cost the owner $50 or $100 for that single meal.

The common and important pests of stored products may be summarized in about five groups, on the basis of what they attack and eat:

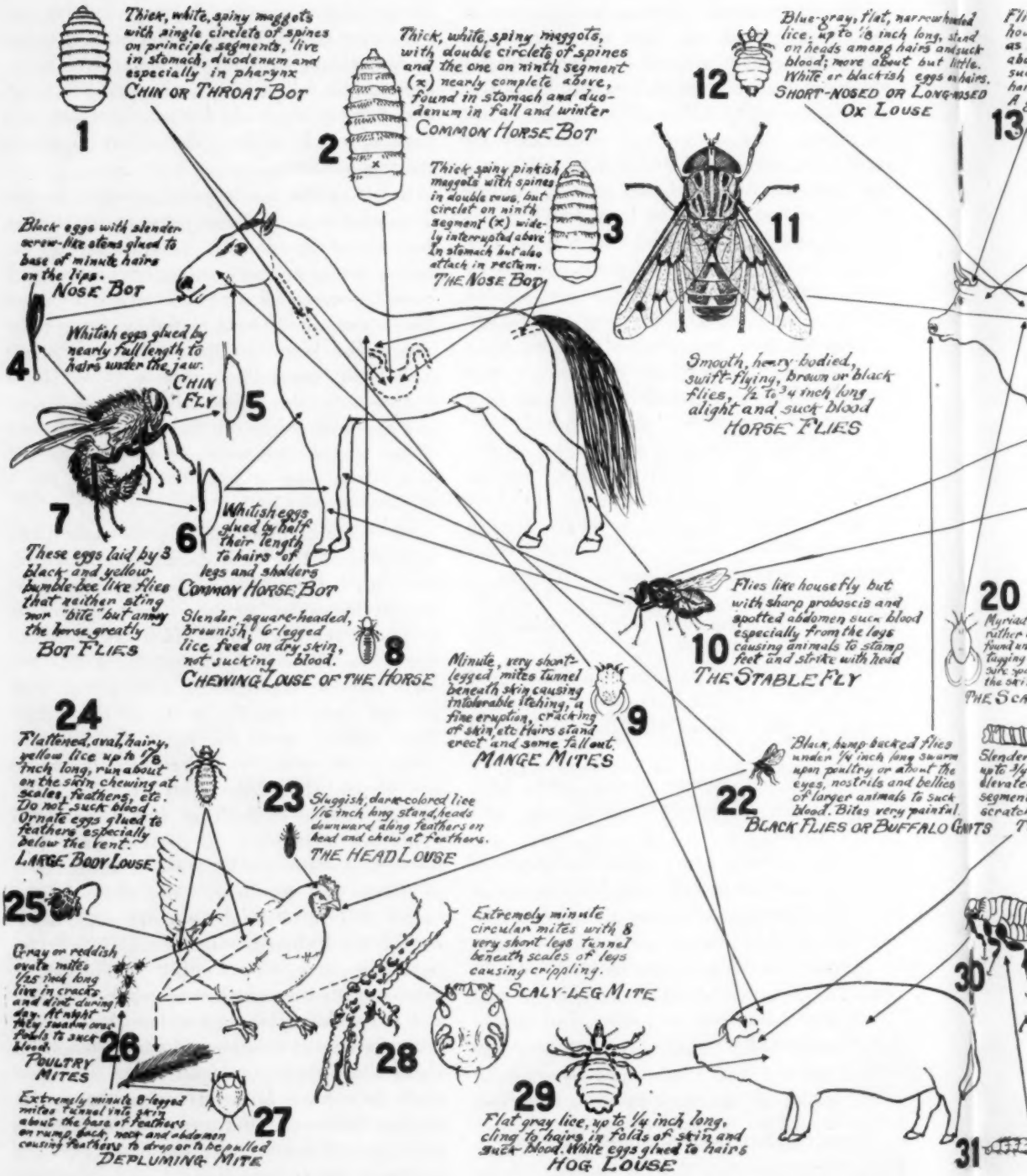
1. Those that damage woolen goods, furs, feathers, mohair, bristles, rugs and carpets.
2. Those which attack wood and paper of all kinds, especially the foundations of the houses in which we live.
3. Those that damage cereal and legume seeds and all products made of seeds.
4. Those which attack meats, cheese and other foods rich in protein and fats.
5. Those which roam about all over our houses, stores, hotels and restaurants at night, eating almost anything they find.

Insects That Destroy Stored Fabrics

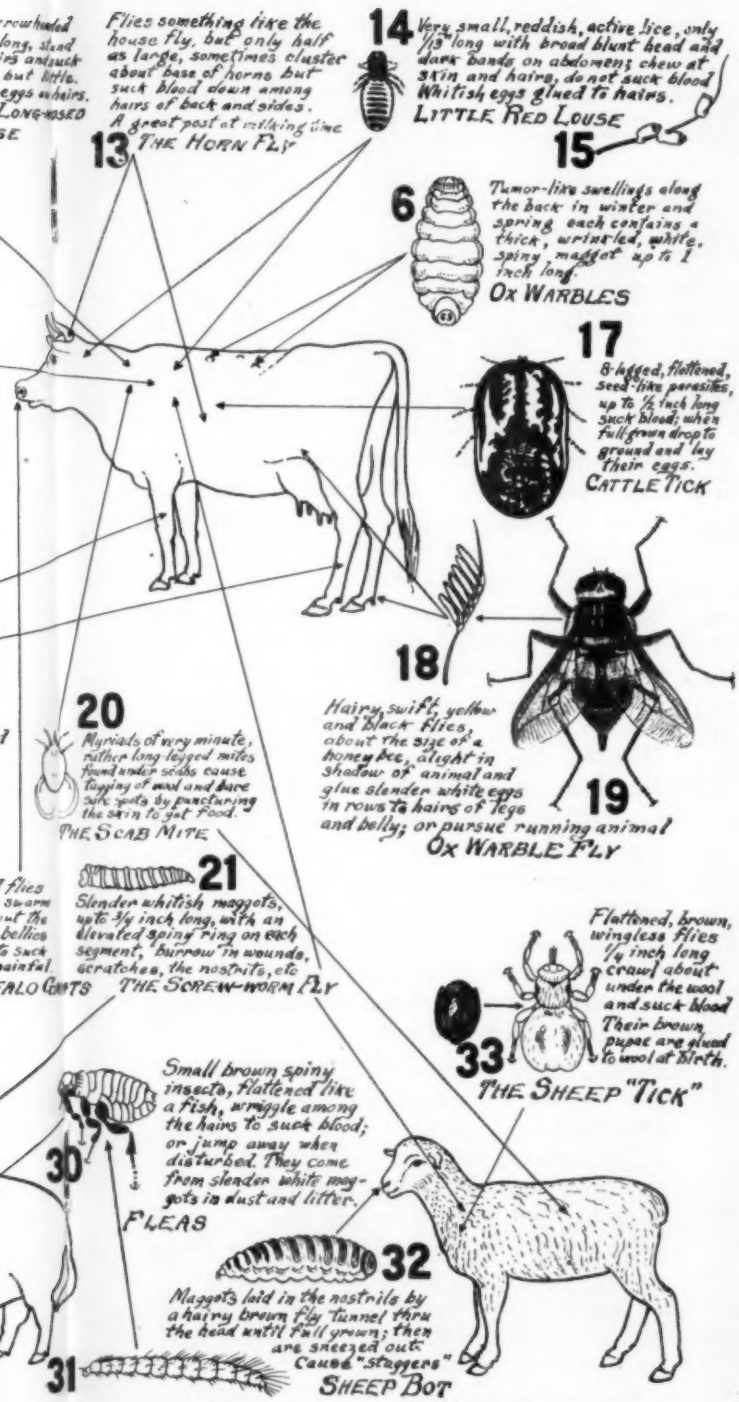
THE INSECTS that destroy stored fabrics are very generally spoken of collectively as clothes moths; but there are two very distinct groups: the true clothes moths, which belong to the same order as the butterflies, and a variety of small beetles. Injury is similar, but the carpet and furniture beetles are somewhat more difficult to eradicate, because they retreat, when full fed, into all sorts of cracks and crevices about the home, where they are hard to reach by any destructive measures except fumigation.

In all of the fabric pests, whether beetles or moths, it is the larva or worm stage that does all of the damage. The larvae of the carpet beetles are very wooly, brownish, short worms, covered all over with stiff erect hairs that are especially long at the tail end of the body. The larvae of the clothes moths are snow-white caterpillars, with a brown head and no noticeable hairs. Clothes moth larvae spin some silk wherever they feed and, in one of the species, the worm is always enclosed in a silken tube or bag that it drags about wherever it crawls.

The stage of these fabric pests most likely to be seen, before their damage becomes conspicuous, is the adults, which are, themselves, entirely harmless, but always start the trouble by laying the eggs from which the "worms" hatch. In the clothes moths the adults are small, tan- or buff-colored millers, not over one-half inch from tip to tip of the wings. These millers avoid the light. Don't worry about moths or millers that come in the house and flutter about the lights at night. But go "all out" after the ones which, when the lights are turned on, go darting away into the darkest corners of the room or under cover of drapes and furniture. The adults of the carpet and furniture *beetles* are very hard-shelled, hard-winged, only one-eighth to three-sixteenths inch long; either all black or mottled with tiny patches of white or white and red scales. They are seldom seen flying, but are attracted to lights and are often noticed about windows, trying to get out of the house after they have laid their eggs upon our choisest fabrics. In the spring of the year the adult carpet beetles are often carried into houses on bouquets of flowers, such as spirea, upon the pollen of which they have been feeding. It is a good idea to shake all such flowers



A diagramatic indication of the importance of insects in affecting the welfare of man, showing the varied w



wing the varied ways they are of great economic importance.

vigorously just before bringing them indoors, else they may introduce some beetles that will lay eggs and start an infestation.

WHEN fabric insects and their damage is discovered, the extent of the infestation should determine the wisest procedure. If the infestation is widespread in the house or in several parts of a single room, a thorough fumigation with hydrocyanic acid is probably the best way to secure complete and permanent relief. This requires the services of a trained pest control operator or exterminator who has the materials, the equipment and the knowledge how to proceed without damaging the property or endangering human lives with this most deadly of all known gases. Another possibility, if you have a well-constructed house and a good heating plant is to kill the insects by superheating. With a good heating system in good repair, on a hot summer day, if the owner will fire his furnace vigorously and raise the temperature in every part of the building to 135 to 140 degrees Fahr., and maintain that temperature for six to eight hours, so that all fabrics, garments, cracks, and upholstery become heated through to the fatal temperature of 135 to 140 degrees for at least 30 minutes, every stage including the eggs of every house-infesting food and fabric insect will be killed. Thermometers should be placed in the coolest parts of the building and examined at half-hour intervals to make sure that the fatal degree of temperature is being maintained.

If the housekeeper watches carefully and so discovers the presence of clothes moths or carpet beetles, while they are restricted to a single clothes closet, trunk, rug, or piece of clothing or furniture, it may be possible to eradicate the pests at much less trouble and expense, by the use of a high-grade

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Science Clubs at Work

Edited by DR. ANNA A. SCHNIEB
State Teachers College
Richmond, Kentucky

• A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Schnieb.

Why Leaves Turn Red

WALTON HAYES
HIGH SCHOOL STUDENT
Breckenridge High School
Morehead, Kentucky

ALL OF us have probably marveled at the different colored leaves which we see in autumn and have wondered at the changes that take place in them, but few of us have taken the trouble to find out nature's secret.

As you know, all living plants, with the exception of the parasites, contain chlorophyll which is a conjugated protein. It is very similar to the haematin, a part of the important respiration pigment of the blood. If we examine the structural formulas of these two compounds we find that the fundamental difference in haematin and chlorophyll is that chlorophyll has an atom of magnesium in the center, while haematin has an atom of iron.

If the haematin in our blood contained the atom of magenisum and the chlorophyll contained the atom of iron, we would blush green instead of red and the leaves instead of being green in summer would be red.

IN THE fall when it gets cold, the leaves stop their process of photosynthesis and the chlorophyll starts decomposing. The products of decomposition form different substances, as anthroquinones (red), xanthones (yellow), flanones (yellow), and anthocyanins. The anthocyanins are the most noticeable because in the fall of the year they give the red color we see in most of the leaves. All these are dyes and if properly extracted and treated could be used to dye cloth. Some of us may have experienced this fact when we have slipped on grass and stained our white clothes, and have found that it could make a very stable dye. These dyes are very similar to the coal tar dyes used for commercial purposes. It seems queer that we let these dyes decompose with the leaves and, after thousands of years, dig them up again in the form of coal and use them to make dyes very similar to the ones we had in the leaf many years before.

The coloring of a leaf in the fall usually starts along the veins. This is due to the fact that the circulation system gets sluggish and the products of decomposition collect there first.

UNLIKE the red and other colors in the leaves, the yellow is not made by the decomposition of the chlorophyll. It is in the leaf during the summer, but due to the green chlorophyll we do not see the yellow until the chlorophyll decomposes. This yellow substance is called carotene, with which we all are familiar in yellow carrots. When carotene is hydrolyzed, that is, when a molecule of water is added, it splits and makes vitamin A, which is very useful to our bodies in resistance to disease, and is being widely advertised at the present time.

The last product of the decomposition of the chlorophyll and carotene is tannin, which is brown and very stable. In fact, in some lakes leaves have fallen into the water thousands of years ago and the tannin has given the water a dark brown color. It sometimes even gives color to the soil where leaves have decayed.

The contrast in color of leaves is largely due to the acidity of the soil and the humidity and

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In the first picture above is shown the nest of the yellow billed cuckoo; in the second, the nest of the house wren; in the third, baby mourning doves.

Photographing Birds' Nests

RAY M. VAN HOOK
Danville, Kentucky

MANY birds' nests are hard to get to and they are often insufficiently lighted, but by using reflecting mirrors, flash synchronizers, and well timed exposures, very many descriptive and interesting pictures can be taken. Frequently limbs must be removed to light the subject properly, and sometimes sides of trees must be cut away as is frequently necessary when photographing the woodpecker family.

In photograph number one, limbs of the shrub were removed so as to expose the nest and the eggs of the Yellow Billed Cuckoo which was about six feet from the ground.

The eggs of the House Wren shown in photograph number two, were laid in a gourd which was in our garage when the nest was discovered. It was carefully removed to the top of an old brick incinerator in my backyard for photographing. The bolt about two inches across, which is shown in the upper left corner of the picture, was placed there for comparison of size. After the picture was taken, the latter part of April, the gourd was put back in the garage and two more eggs were eggs were laid.

In photograph number three, showing baby mourning doves in nest, the nest had to be tilted by one of my companions so that sufficient light from the late evening sun would shine on the subject. My friend's hand can be seen in the lower right corner of the picture. The nest was in a cedar tree in a grove of cedars, about five feet above the ground and was made of coarse cedar twigs, very loosely put together which made a shallow plate-like nest.

Nest of the meadow lark.

More "Chem-Teaching" Tips

CARROL C. HALL

Springfield High School — Springfield, Illinois

Chem Cards. Use the old-fashioned FLASH CARDS for teaching and review on symbol, formula, valence — and other types of sheer memory drills. It's elemental and the kids like it.

* * *

THE APPLICATIONS OF CHEMISTRY should be introduced by the instructor in the lecture sessions. There are too many applications for them to be discussed in the average text and, in addition, the youngsters have their minds full trying to master fundamentals. You can introduce them as "color" material to the routine work.

For example, during the discussion of Hydrolysis do you ask them why Dad takes Baking Soda for a sour stomach on the morning after the night before?

* * *

There is plenty of *DRAMA IN THE HISTORY OF CHEMISTRY* and an occasional story will "color" up a class session. Please keep in mind however that the average high school pupil is interested in the future not the past — only older folks can appreciate history.

Here are some incidents that might be of interest:

Story of Cavendish
Frasch and the Sulphur process
Madame Curie
Haber and World War
Isolation of the Element Fluorine

* * *

STREAMLINE THE MATERIAL YOU REALLY WANT LEARNED Take an annual inventory of the fundamentals absolutely essential to an understanding of Chemistry and teach only those. You'll be surprised how many things in the text we can get along without.

* * *

Don't Worry if you can't get through the book or your youngsters seem slow to understand. Remember that scientific thinking evolved slowly out of the race, Chemistry as a science is less than 200 years old; and we are trying to cram this knowledge into the heads of boys and girls in the space of a few short weeks. (Also, only a few of the human race were leaders in the development of the science, the great mass of people knew nothing about it or could even comprehend it!)

* * *

CHECK THE PHYSICAL DEFECTS of students and make special provisions for their comfort, etc. These people are handicapped enough without the additional ones which may be added in the classroom.

* * *

A SEVENTH INNING STRETCH is a good idea during any class session. Don't take your instruction too seriously and become oblivious to human physical comfort.

* * *

BEWARE: of the music of your own voice. You can drone on and on forever. That's just what the class wants — a chance to rest while you blab.

* * *

DISCIPLINE is a mechanical process. If you have your work planned — both for self and class — there'll be no trouble. Take a tip from an old-timer.

* * *

PLAN WITH YOUR CLASS the sessions from one to two weeks in advance. There are no alibis then as to what should have been studied, or make-up work and any number of other petty details that give teachers grey hairs.

* * *

FUN IN CLASS — certainly! And, lots of it. True you're going to have to put the brakes on for some of the immature intellects — but that's part of the training during this important "growing up" period.

Program of Department of Science

Missouri State Teachers Association

An Affiliate of the American Council of Science Teachers

Friday, November 5, 1943, St. Louis, Missouri

Morning

9:45—Discussion Group. Topic: *A Survey of Pre-Induction Science Training.*

I. Pre-Induction Needs from Experience in Pre-Flight Training.
Dr. W. A. Buckner, State Teachers College, Cape Girardeau, Missouri.

II. Pre-Induction Program in the High School.
Mr. John Mason, Laboratory High School, University of Missouri.

III. Pre-Innduction Training from the Viewpoint of the War Department.
Lieutenant Daniel C. Naughton, formerly of Stanford University and Greeley, Colorado, and the Pre-Induction Training Branch of the War Department.

Alternates: W. D. Bracken and Joseph Castelli. Each speaker will be followed by a discussion period.

12:30—Luncheon and Afternoon Session—Hotel DeSolto.

Afternoon

1:30—Lex Terrae (or What Men Live By).
Dr. Rudolf Bennitt, University of Missouri.

Pre-Induction Needs That Can Be Met by the Science Teacher.
Lieutenant Daniel C. McNaughton, War Department.

Business Meeting.

FIVE MINUTE QUIZZES at the beginning of class sessions, frequently and on lab or class work — do a lot to keep the gang on their toes. Don't use stereotyped "book" questions. Devise some ingenious brain twisters — that really make the gang apply their "memorized" details.

* * *

INSPIRATIONAL TALKS — sure once in a while, that is if you can keep your pet prejudices under control and have really thought the idea through. The adolescent needs his "emotional battery" charged once in while — they're idealists, remember that!

* * *

Your Voice is the most used teaching tool. To everyone except yourself it may sound like the "old dabil" himself. Too bad that teacher-training doesn't include special instruction in tone control. Watch out for high pitch, monotone, lack of flexibility, well pronounced words. Incidentally, good grammar is caught not taught.

OLD TESTS make good teaching material. Excellent for study periods. If they are printed, standardized forms that's all they're good for!

* * *

Eyes are precious. Are you insisting upon best conditions of lighting in your rooms. If not for your class, what about for yourself?

* * *

INSIST that the subject at hand be read over at least once by the pupils before your discussion in class session. The persons who get the most from the lecturer are those who are nearly as well informed as he is.

* * *

TIME OUT ALWAYS for questions from the class. Reserve the right, however, to nip off any question that shows lack of study or is asked just to create an impression. As a teacher do not hesitate to say to the questioner: "Look it up in the book, that question is answered there."

SULFA DRUGS

Continued from page 9

in the treatment of malaria, typhoid fever, syphilis, and tuberculosis.

ONE OF the important phases of the use of sulfa drugs is in phophylaxis. Soldiers carry tablets of sulfathiazole and are asked to swallow them at the moment of getting wounded or burned. Patients to be operated upon are given sulfathiazole in anticipation of a possible infection as a complication of the operation. In recent months, sulfaguanidine and sulfasuxidine have been given in preparation for operations involving resection of the bowel. Furthermore at the time of operation when the abdominal or other cavities are opened, 5 to 10 grams of powdered sulfanilamide or sulfathiazole are sprinkled over the site of the operation, particularly if there is any evidence of infection in the region. All of these procedures have markedly diminished the incidence of infections in wounds, burns and operations, and are now accepted procedures.

Toxic Side Reactions

IT IS unfortunate that the sulfa drugs are not without their danger. But it was to be expected that a drug that interfered so drastically with the life cycle of bacteria should have some effect upon the tissues of the host. And this proved to be the case. The toxic manifestations of the drugs are of two types; first, the direct action of the drug on the various tissues chiefly because of overdosage or of too prolonged use, and secondly, sensitization reactions produced in some persons who have been previously sensitized to the drug itself or to a chemically related compound. The latter type is the less common but is more serious.

Mild reactions are not infrequent during the use of the drug, but severe or fatal complications are rare. Therefore there is seldom any contraindication to the use of sulfa drugs, except where sensitization has definitely been established. The mild reactions include one or more of the following: nausea and vomiting, fever, slight cyanosis, mild anemia, and mental confusion. In such cases, if the infection is serious, it is not necessary to stop the use of the drug. The dosage may have to be altered, or another sulfa drug substituted for the one giving the reaction. The more serious complications are skin rashes, high fever, blood in the urine, decreased output of urine, severe anemia, diminished white cell count in the blood, jaundice, muscular weakness, and neuritis. When any of these symptoms are found, the drug must be discontinued immediately and measures taken to combat these symptoms.

IT CAN be easily recognized, then, that the use of the sulfa drugs in the prophylaxis and treatment of disease should not be undertaken without the vigilance of a physician. They cannot be used with the casualness with which aspirin or a cough medicine is used. Inadequate dosage of the drug is not only futile but dangerous, because it causes the loss of valuable time in the treatment of the disease. Too large a dosage or too prolonged a treatment is harmful too because of the toxic reactions. Sensitized individuals may show severe reactions even with small doses. Only a physician is experienced enough to recognize the indications and contraindications to the use of sulfa drugs, and the dosage required at any particular time, and the manifestations of intoxication.

Mode of Action

SEVERAL theories have been presented as to how the sulfa drugs produce their therapeutic effects, but none has been proved and none is complete. It was recognized from the first *in vitro* studies that the sulfa drugs inhibit the growth of bacteria without being bacteriocidal. This inhibition is regarded also as the chief action *in vivo*. The drugs do not act as an antitoxin, nor do they promote the formation or the action of antibodies. This fact is important clinically as well as bacteriologically, because the cure produced by sulfa drugs does not in itself produce immunity from a repeated infection. The host's response during treatment is important but is independent of the action of the sulfa drug.

Of the several theories offered to explain the action of sulfa drugs the most recent has been the most intriguing both to the bacteri-

ologist and to the biochemist. It had been learned that when extracts obtained from a streptococcus culture are added to another culture containing a quantity of sulfa compound usually sufficient to inhibit the growth of the culture, this addition annuls the sulfa drug effect and permits the bacterial growth. The active compound in this extract was found to be p-aminobenzoic acid, which is strikingly similar in chemical composition to sulfanilamide. This compound is one of the members of the Vitamin B complex. It is therefore believed by Woods and by Fildes that sulfanilamide and p-aminobenzoic acid compete for certain enzyme systems which are necessary for bacterial growth, and that in the presence of limited amounts of p-aminobenzoic acid (which would always be the case *in vivo*), sulfanilamide is accepted sufficiently by the enzyme system instead of the p-aminobenzoic acid to limit the reproduction of the bacteria. This idea has been further extended to explain the greater efficiency of the other sulfa drugs. For along similar lines, sulfapyridine competes with nicotinic acid (which like sulfapyridine contains the pyridine nucleus) for certain oxidation-reduction enzymatic reactions, and sulfathiazole and sulfadiazine compete with thiamin (which contains both the pyrimidine and the thiazole groups) for its special enzymatic reactions.

Such a theory would require much more experimental proof before even limited acceptance. But the very nature of the theory implies that not until the biochemical aspects of bacterial and human metabolism are much better understood can one expect to get any fundamental notions about the actions of drugs in the treatment of infections.

Conclusion

THE AMAZINGLY rapid developments in the use of sulfa drugs represents one of the most important advances ever made in medicine. This rapid growth has been made possible by that type of medical research which shows the trend of these times: a "combined operation" involving the facilities of the organic chemist, the bacteriologist, the immunologist, the biochemist, the pharmacologist, and the clinician. One may expect even more amazing advances in this field in the next decade.

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LINEAR EXPANSION

Continued from page 15

parallel, and between these blocks and the bottom shelf are placed four small finishing nails to serve as rollers so the system will move smoothly.

To the right of the lower piece of glass tubing is fastened a small block of wood. Under this block is a nail to which is attached a cork through which a piece of wire 14 inches long serves as a pointer moving over the scale X, Y and Z. A small counter weight in the form of a coil of iron wire is provided to take care of the weight of the pointer. A laboratory weight on top of the block serves to provide the necessary friction to prevent the pointer from moving only when expansion takes place. All this is shown in Fig. 2.

Briefly the appartus functions thus: a small boiler is connected by means of a piece of rubber tubing to the left end of the upper glass tube. As the steam flows through the glass tube and causes a rise in its temperature, it expands and moves the whole system to the right. The wire pointer moves from Y to Z. When the steam passes into the tin tube and causes it to expand, that portion of the system lying beyond the tin tube is moved to the left. The pointer moves from Z to X. Finally, when the steam enters the lower glass tube, the expansion of this tube will move the pointer once more to the right, that is from X to Y and come to rest.

From this it is evident that the expansion effects of the glass are in the same direction and opposed to that of the tin. It follows, that if the lengths of glass tubing and tin tubing are properly chosen, the net result will be zero, that is, the pointer will be in the same position when the tubes are all heated by the steam flowing through them, as when they were cold.

THE ARRANGEMENT of the tubes in this appartus corresponds to the rods on a compensated pendulum. The glass tube clamped

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IMPORTANCE OF INSECTS

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household spray containing Lethane, pyrethins or rotenone, applied to the infested rug, davenport, clothes or room, and to all adjacent cracks and crevices in floors, shelves and baseboards. Repeated sprayings will probably be necessary; only those pests actually wet by the spray will be killed.

A SINGLE room or closet may also be fumigated if it is sealed very quickly and tightly after the poison is released in it, by covering every crack, keyhole and other opening with masking tape. Although not nearly as deadly to the insects as the gases used by professional exterminators, a very safe fumigant to use in homes is a mixture of three parts of ethylene dichloride and one part carbon tetrachloride. This mixture has no fire hazard and is not dangerous to breathe, nor harmful to fabrics or woodwork unless the liquid is spilled. It requires about three or four gallons of the liquid to treat each 1000 cubic feet of space: that is a room about ten by twelve feet. The liquid should be poured out in broad shallow pans, filled with rags, the room promptly closed and sealed, and the gas allowed to operate for at least 24 hours, then opened and thoroughly ventilated before it is reoccupied.

The good, old-fashioned house-cleaning procedure in which every article of clothing, furniture, rugs, carpets and draperies, was moved out doors, aired, sunned and beaten at least once a year: an upheaval that was very likely to cause Dad and the children to tear their hair and foul their tongues in protest, is even more disturbing to clothes moths and carpet beetles. The modern vacuum cleaning is a pretty good substitute, except that it is likely to lead the housekeepers to think that it is unnecessary to move everything about at intervals and so some of the secluded points of infestation are likely to be left undisturbed. It is very important in order to prevent these fabric pests from becoming established in your home to continually eliminate all dust and

lint, not only from exposed surfaces where it is visible, but even more important, from cracks, hot air furnace pipes, the interior of pianos, and similar places where dust is apt to be neglected, because it is invisible to the housekeeper or her callers, but provides a nest where hundreds of carpet beetles or moths may develop and spread to rugs, clothing and furniture. Naphthalene and paradichlorobenzene are useful repellents against these pests in articles to be stored during the summer; but they should not be applied in rooms or closets which are being occupied, for continued breathing of such fumes is harmful to man. In fact no insecticide can be used to kill these pests in rooms that are being used continually, for any chemical that will poison the atmosphere will kill man long before it kills these insects.

THERE are some excellent moth-proofing materials that will serve as repellents to keep the insects from attacking fibers, which can be applied to clothing, rugs or upholstery that are in constant use; but there are also some useless, fake, so-called moth-proofing materials on the market. Fabrics treated during the manufacturing process, preferably in the hot dyeing bath, with such products as "Eulans" and "Demotex" will often retain their moth-proof properties for years or until they have been washed or dry-cleaned many times. The best moth-proofing material for the home-owner to apply to his clothing, rugs, furniture, and draperies after they are manufactured, I believe to be the product called "Konate." It is not poisonous and therefore not dangerous to use, but is so bitter to the taste that even the hungriest of larvae will not eat fabrics that have been thorougly moistened with it. Articles moth-proofed with Konate, Eulans or Demotex can be used continually without any danger to the family.

PHYSICS AND WAR

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blows, the liquid does not flow apart, but cracks like glass, crumbles like a brittle body.

There are a great number of other problems. Our remarkable tanks and motors comprise an enormous number of physical problems from the viewpoint of combustion, thermodynamics, lubrication, and so on. Certain technical problems now acquire a great significance in defense, as for instance the work on liquid oxygen. In this connection, the apparatus devised by Academician Kapitsa for the production of liquid oxygen is especially important. Many civilian problems can be solved by this means, and materials and products can be freed which can be used directly in the war. Some of the problems make extremely difficult demands on the delicacy and accuracy of observational methods.

Physics has proved useful in war time, but at the same time war and preparation for war set new problems and consequently influence the development of physics. Physics not only gives much to military technique, but it also receives very much from it. The constant competition of methods of attack and means of defense always poses two-sided problems and demands a whole series of new solutions.

We entered the present war under conditions where the attack, in aviation, was vastly stronger than the defense, and hence it turned out to be of extreme impotrance to work on the defense against raids: the quickest possible discovery of the plane, the most exact definition of its position, accuracy of A-A fire, and the invention of other methods of coping with the plane. If we compare the devastating effects which the raids on the cities of England had in the beginning of the war with the results which the Hitlerites were able to obtain, with the utmost exertions, in bombarding Moscow and Leningrad, it can be seen with complete clarity how strongly our Union has developed methods of defense against aerial attack, and how ineffectual the German raids are here in comparison with what they were able to accomplish in England, which at the outset was unprepared in this respect.

We well remember the successful drive of the German tank columns in France, and we know how our aviation is coping now with the German tanks, and how many weapons we use in this struggle: inflammable bottles, grenades, anti-tank guns. All this has made tanks in our campaigns by no means as dangerous and irresistible weapons as they were quite recently at the time of the attack on France. Military technique is not immobile. Soviet science is purposefully directed, not only toward the abstract problems of pure science, but also to the constant utilization of its knowledge for military technique in the service of humanity.

AT THE session of the Academy of Sciences our president, Vladimir Leontevich Komarov and Ivan Pavlovich Bardin spoke of the imposing work of defense in the mobilization of the resources of the Urals and other more easterly regions of our Union. This is one side of the problem which is extremely important, inasmuch as we could do nothing, of course, if we did not mobilize our resources and had no iron, coal, energy, copper and aluminum. But there is another side just as important—the perfection of technique. Not only must we have material for war industry, not only must we build and produce wisely, but we must find new, ever more effective methods of construction.

From the problems of this war we not only have learned to work in a new way, not only have we worked out new, vastly more delicate, accurate and more trustworthy apparatus of observation, but we have discovered a whole series of new phenomena in the course of the solution of the problems raised by the front.

Acquaintance with the production side and the conditions of mass production have proved very valuable to us physicists. Many physicists, who had a merely theoretical experience, derived from the laboratory, now have mastered constructions, new factories and conditions of industry. They have acquainted themselves with technology, have begun to evaluate the economic factor more correctly, to see the significance of economy and simplicity in methods of production. This

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SOME PROPOSALS

Continued from page 13

emphasize long range goals of science teaching. These goals should be analyzed realistically and with intellectual honesty so that science education may make its fullest contribution to the personal and social problems of our young people and society. It is assumed that many areas to which science education can contribute with peculiar effectiveness have not been attacked by science teachers with sufficient emphasis. Among these are problems of health, conservation, production and distribution for the needs of a democratic people, support of research, scientific advance, consumership, cooperation with other cultural groups for world stability, national and world resources and their equitable distribution.

V. The problems of scope and sequence in science education, and the problems of improving instruction through increasingly valid teaching technics are functions of the goals of science education in a nation at war. They should be evaluated as such. Once goals are validated, recommendations of time allotment, necessary material facilities, and sound teaching procedures may, and should be, prepared by the ACST.

VI. Industry and the armed forces have drained the schools of competent teaching personnel to the point that the schools now face a critical manpower problem. The problem of staffing our schools for sound science instruction should receive the immediate attention of the ACST. The problems of in-service education and conversion of teachers from other fields demands immediate analysis and action.

VII. The American Council of Science Teachers should investigate ways by which science teachers may be encouraged to remain at their posts rather than leaving for other service.

VIII. Upon the basis of the above considerations a wartime platform of science teaching should be developed, published, and released

to the educators of the country. This should be based upon careful analysis of all problems addressed but must be done expeditiously for effectiveness in offering leadership. It is recommended that such a publication be released to the schools not later than October, 1943.

IX. Teachers of science-in-training should be admitted to membership in the ACST. Appropriate modification of the constitution should be made to admit this group. It is believed that one of the best methods of encouraging and securing effective membership in the American Council of Science Teachers is through contact with teachers-in-training and through offering them the advantages of participation in the activities of the Council.

Norman R. D. Jones, *Chairman*
Dr. R. W. Burnett
Ira C. Davis
Earl R. Glenn
Franklin Mathewson
Esther Scott.

STATEMENT OF OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

★

Of *The Science Teacher*, published 4 times per year at Normal, Illinois, for October, 1943.

STATE OF ILLINOIS, County of McLean, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared John C. Chiddix, who, having been duly sworn according to law, deposes and says that he is the owner of *The Science Teacher* and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodeid in section 537, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—John C. Chiddix, Normal, Illinois.

Editor—John C. Chiddix, Normal, Illinois.

Managing Editor—None.

Business Manager—John C. Chiddix, Normal, Illinois.

2. That the owner is: John C. Chiddix.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent of total amount of bonds, mortgages, or other securities are: none.

JOHN C. CHIDDIX.

Sworn to and subscribed before me this 4th day of October, 1943.

(SEAL) (My commission expires, Jan. 18, 1944.)
Ethel Pace.

PHYSICS AND WAR

Continued from page 34

new knowledge is important not only today, but for all the future development of our science, when we shall have to solve the problems of peaceful construction and new technique.

SOVIET science, which over the space of twenty-five years has been attentively nurtured by the Soviet power, and for which were created unprecedented facilities — a multitude of institutes, splendidly equipped and organized on a well-thought-out plan, covering all sides of science and all its results—has quickly mobilized new scientific knowledge which arises on the border between the separate sciences, between biology and physics, between physics and geology. Today, when our material strength and the level of our technique are undergoing their severest test, such a position of science in the Soviet Union gives it enormous advantages. Our enemies barbarously persecute science. In fascist Germany it is replaced by superstitions and racist ravings; there books are burned and the best achievements of science are destroyed. Germany, which reckoned that by the creation of military technique alone it could attain superiority and victory, has miscalculated. A military technique can not be powerful, on no matter how high a level it stands at the outset of the war, if it can not in the course of the war quickly adapt itself to the requirements that the war brings forth. Such a technique can not exist without deep roots in science. Destroying science, Germany dug up the roots of all technique, and in particular military technique, which makes exceptionally great demands of science. Germany acted like that person in the story who sawed off the branch he was sitting on in order to get a little wood. Of course, the branch broke and he fell and was crushed. The same fate inevitably awaits fascist Germany, which has sawed off the limb on which it sat, for military technique without science is impossible. And the existence of fascist Germany, which is reactionary in its very essence, is incompatible with progress, with freedom, with real science. It must perish when it clashes with an advanced country in whose life science is an essential part. The result is inevitable—superstition must go under.

To Hitler's miscalculation on a blitzkrieg, to his false hopes for the creation of national divisions between the various peoples of our multi-national fatherland, divisions which have disappeared under the Soviet power, to the false hopes of fascist Germany based on our supposed backwardness and weakness—to all the miscalcualtions is added the greatest error of all, which by her very nature fascist Germany failed to take into account, namely the enormous significance of science in our country, the impossibility of divorcing technique, and military technique in particular, from our advanced science. Science proves to be a mighty factor in modern war.

★

WHY LEAVES TURN RED

Continued from page 26

temperature of the region. In the Knobs region of Kentucky where the soil is very acid there is a brilliant display of bright colors in the autumn, but in the lime-stone region of the Bluegrass the colors are not as bright, but are of a dull hue. An example of the effect of humidity and temperature on leaf color is shown by the fact that in Kentucky in 1941 the leaves did not change their color much until November. This was due to an unusually warm fall and heavy rains following a very dry summer. Usually in the same region, leaves change their color in early October and the trees are bare by November.

IN CLOSING I quote from a poem that really has moved me to find out more about "Why the Leaves Turn Red in Autumn."

"From hedgerow, law, and wooded hill
Departs the summer's chlorophyll;
The elms and hickorys lose their green
And glow instead with carotene.
While sumacs, maples redden in a burst of
anthocyanin—"

SOURCES:

Time Magazine, Oct. 20, 1941
Chemistry of Plant Life by Thatcher
Recent Advances in Organic Chemistry by Stewarts

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LYONS AND CARNAHAN

CHICAGO DALLAS LOS ANGELES ATLANTA NEW YORK

ARMY DOES NOT DICTATE

Continued from page 14

cal Education Health Committee; A. H. Pritzlaff, American Association for Health, Physical Education and Recreation; Zachariah Subarsky, American Science Teachers' Association; M. A. Russell, National Association of Biology Teachers; and Dr. Philip G. Johnson, Cornell University, who acted as chairman of the group.

This manual, *Physical Fitness Through Health Education*, was considered excellent, but there was a unanimous feeling that it should be implemented with helps for the classroom teacher so that the inexperienced teacher or even one having majored in other fields could be brought in to the health program. Consequently, on June 16, 17 and 18, Messers Brantwein, Johnson, Jones, Russell and Zubarsky met with Dr. Burnett of the Pre-Induction Training Branch of the War Department.

IT WAS agreed that an extensive source book of suggestions containing activities with their desired outcomes, practical applications, projects, experimental demonstrations, laboratory work, films, charts, models and reference books, would best meet the needs as presented by the representatives of the War Department. The material to be presented was divided into four units — communicable diseases, diet, prevention of accidents and treatment of injuries, and mental health.

This health program could be adapted for use in connection with the 10th year biology program although it was developed as a one semester course for the 12th grade, for either boys or girls, for the semester prior to induction in the armed forces.

★

The Proctor and Gamble Company, Cincinnati, Ohio has prepared a boklet entitled "Vital for Victory." This booklet presents the many ways in which a soap company serves the nation during a war period. It's free.—ACST.

PRE-INDUCTION RADIO

Continued from page 16

Next an electric phonograph and audio frequency amplifier was built. The phonograph is used to play the code records, and the amplifier section is used to bring small receivers up to loudspeaker volume. What a thrill it is for a boy to listen to his home made crystal set make the loudspeaker roar!

Several code practice audio frequency oscillators have been constructed and are used daily. One of the best demonstration units is a radio tube demonstrator built by a tenth grade boy. With this demonstrator students obtain data for making grid voltage-plate current graphs.

ANOTHER much used piece of equipment is a medium powered radio frequency oscillator. With this oscillator and an extra coil and variable condenser *resonance* or tuning is demonstrated. The bright glow of the neon tube really shows parallel tuning for radio frequency voltage. Series tuning for radio frequency current is shown by the bright illumination of a flashlight or dial light bulb when the coil is tuned to resonance by the variable condenser. With this demonstration, resonance or tuning acquires some real meaning instead of being the "condition that exists when the inductive reactance is equal to the capacity reactance."

The oscillator can also be used to show how different sized coils are used to obtain different frequencies. There is a one turn coil which will cause the oscillator to generate frequencies as high as sixty million cycles per second. Other coils can be used which give the oscillator various ranges of frequencies down to frequencies as low as the broadcast band (1500 K.C.). The range could be extended still further by constructing a larger coil.

STUDENTS have shown great interest in a "wired wireless" radio station which has been constructed and placed in a small dressing room off of the stage. The radio frequency electricity is coupled to the electric light wires. The electric light wires carry the radio frequency electricity throughout the school where

it can be heard in receivers using the electric light wires as the receiving antenna.

Plans are being made to transmit "wired wireless" messages to and from Redford High School about four miles away. A complete radio telephone transmitter is being constructed with the idea of using it in an amateur radio station after the war is over.

Several teachers have brought in radios to be repaired. These teachers have been glad to pay for the repair work by contributing to the school radio fund.

MANY more projects will be planned and carried out. Among the possibilities are a miniature ultra high frequency radio airplane beam, a radio compass, radio control of model airplanes or electric trains, public address system amplifiers and construction of testing equipment.

The student and teacher cooperation in designing and constructing equipment from "junk" parts helps to develop originality, resourcefulness and analytical thinking.

LINEAR EXPANSION

Continued from page 31

to the upper left hand corner of the supporting board, corresponds to the suspension of the pendulum and the pointer at the end of the lower glass tube to the pendulum bob. The adjustment of the length of the tubing is simply determined by applying the coefficients of expansion of whatever substance is used. In the case of tin and glass: the coefficient of expansion of glass is .000085, that of tin .000022. Determine the number of times tin will expand compared to glass, to get the length. You will find tin will expand 2.6 times as much as glass. If the tin tube is 30 inches long, one will need 2.6 x 30 or 78 inches of glass tubing to compensate for the tin expansion.

The cost of this equipment is practically nothing except for the glass tubing and rubber tubing. It makes an excellent group project for any physics class or science club. When this is demonstrated to a class some pupil exclaimed "Well! What do you know about that?

NEW BOOKS ANNOUNCED

Unified Physics. Fletcher, Mosmacher, and Lehman. McGraw-Hill Book Company, N.Y. 1943, revised edition. 713 pp. 12.5x19.5 cm. 756 illus. $1.80.

Science. Ira C. Davis, Head of Department of Science, University High Scohol, University of Wisconsin and Richard W. Sharpe, formerly instructor in science, George Washington High School, New York City. Henry Holt and Company, 1943, revised edition. 495 pp. 15x23 cm. 403 line drawings; many pictures. Teachers manual. $1.84.

Mathematics of Flight. James Naidich, Chairman, Departmentof Mathematics, Manhattan High School of Aviation Trades, New York City. McGraw-Hill Book Company, New York, 1943. 409 p.p. 15x23 cm. 396 illus. $2.75, list.

Elements of Radio. Charles I. Hellman, Instructor in Physics, High School of Science, New York City. D. Van Nostrand Company, New York, 1943. 318 pp. 15x23 cm. Well illustrated. $2.00, list.

Vitalized General Biology. Barclay M. Newman, formerly Head of Science Department, Brooklyn Academy, Brooklyn, N. Y. College Entrance Book Company, New York City, 1942. 356 pp. 12x18.5 cm. Illus. in two colors.

Directed Activities in Chemistry. Baisch, Gladieut, and Goodrich. Workbook and Laboratory Manual. Separate objective tests. Oxford Book Company, New York, 1939. 306 pp. 75 cents.

Basic Electricity. Wilbur L. Beauchamp and John C. Mayfield. Scott Foresman and Company, Chicago, 1943. 312 pp. 19.5x28 cm. 305 illus. $1.60, list.

Map Reading and Avigation. Richard M. Field, Princeton University; and Harlan T. Stetson, Massachusetts Institute of Technology. D. Van Nostrand Company, New York City, 1942. 129 pp. 21x28 cm. 83 illus. $2.50, list.

BOOK SHELF

MODERN PHYSICS. Charles E. Dull, Supervisor of Science for Junior and Senior High Schools, Newark, N. J. Revised edition. Henry Holt and Company, New York, 1943. 597 pp. illus.

In *Modern Physics*, revised edition, is retained all the clear presentation of the 1939 text for which Dull's Physics is known, and a number of improvements have been made. The work in the presentation of color is especially noteworthy. The book is profusely illustrater, many line drawings especially being used. These are particularly helpful in explaining how a thing works. The material is presented largely in terms of human experience, especially that of interest on the high school level. Questions and problems are placed near the material to which they are related and not segregated at the end of the units.

PREPARE YOURSELF! *Physics Laboratory Workbook.* Tuleen, Porter, and Houston. Scott, Foresman and Company, Chicago, 1943. 298 pp. 60 experiments, 80 illus. Paper bound. 96 cents, list.

Prepare Yourself is a laboratory work book in physics of a practical nature that permits the student to work out the problems of physics in terms of the materials of his environment. It is flexible in use, being organized in ten units, covering the usual areas of physics. In each unit there are four or more experiments with nineteen in electricity and radio. Useful orientation material for each experiment is given preceding the directions for the work. The questions given in the practical applications at the end of the experiments are well suited to making clear the principles involved and their usefulness.

VITALIZED PHYSICS. Robert H. Carleton, Head of Department of Science, Summit High School, Summit, N. J. Edited by Michael N. Idelson, Head of Physical Science Department, Abraham Lincoln Highschool, Brooklyn. College Entrance Book Company, 1943. 378 pp. Illustrated.

The use of two colors in presenting the principles of physics in this text makes it particularly striking for the student and should serve as a real advance in the technique of text presentation. An examination of the book is needed to fully appreciate the advantage thus gained.

The material is quite up-to date and includes examples and applications taken from the present that are not only of special concern in time of war but also for the peace. Some of the newer topics included are radio and physics of the airplane. The mathematics of physics is emphasized.

AIR NAVIGATION, *Part Three.* McGraw-Hill Book Company, 1943. 80 pp. Photo-offset process. $1.00, list.

This volumn introduces some basic applications of the fundamentals covered in the preceding volumes. It explains certain methods used to check the position of a plane during flight. Effects of air currents on the movement of the ship are studied.

CHEMISTRY IN WARFARE. William Lemkin, Department of Chemistry, High School of Commerce, N.Y.C. Oxford Book Company, New York, 1942. 21 pp. illus. 10 cents, net.

This booklet provides valuable material on chemistry in warfare and is especially useful to supplement the regular chemistry text being used. The subjects discussed include explosives, cartridges, bombs shells, incendiaries, and poison gas.

ONE THOUSAND PRE-FLIGHT PROBLEMS. Thompson and Aiken. Harper and Brothers, New York, 1943. 160 pp. Paper, 88 cents; Cloth, $1.20.

The book seems to provide an answer to the demands of pre-flight teachers for pupil activity materials. The problems seem especially practical in that the names of actual makes and detailed parts of planes are freely used, as well as names of specific locations and meteorological conditions. This problem book would prove practical in connection with any basic text or teaching procedure in the field of pre-flight aeronautics.

Nathan A. Neal

LABORATORY MANUAL IN RADIO. Almstead, Davis, and Stone. McGraw-Hill Book Company, 1943. 139 pp. Paper cover. 80 cents, list.

The basic skills and fundamental principles found in any elementary course in radio are covered in a series of thirty-six laboratory exercises. The materials required for each exercise are clearly enumerated, and the values of different units are specified.

J. S.

EFFECTS OF FLIGHT. McGraw-Hill Book Company, New York City, 1943. 124 pp. 60 cents, list.

Both the layman and the aspiring aviator will find this interesting and profitable reading. Both physical and mental aspects of the body, as affected by flight conditions, are

carefully explained. The reader is well appraised of the difficulties encountered in flight training.

J. S.

AEROLOGY FOR PILOTS. McGraw-Hill Book Company, 1943. 107 pp. $1.25, list.

This addition to McGraw-Hill's Flight Preparation Training Series, with its well prepared pictures, charts and cartoons, makes delightful reading for the youngster eager to learn about aviation. It is worthwhile reading, too, for anyone interested in an up-to-date explanation of weather phenomena. It includes an explanation of air masses and fronts.

ELEMENTS OF CHEMISTRY. Brownlee and Others. Allyn and Bacon, Boston, 1943. 684 pp. 428 illustrations.

This text in high school chemisty is not to be confused with the usual review edition in which a few changes are made, but represents a completely rewritten text, simplifying the explanations, adapting to the present, and making use of a great many new pictures and well drawn illustrations. In general, the plan or organization is quite similar to that of the earlier text by these authors. The teaching qualities of the book have been improved.

AMERICA AT WORK SERIES: *Machines for America*, 164 pp., 80 cents; *Power for America*, 164 pp., 80 cents; *Wings for America*, 244 pp., $1.00. By Marshall Dunn and Lloyd N. Morrisett. World Book Company, Yonkers, New York, 1943.

This series of texts, suited to the upper elementary and junior high school grades, presents concrete pictures of our great industries, sources of energy and technological advances. They deal in both a factual and itneresting way with the place of machines in our lives and in the life of our country; the principles involved in production of power and also its contribution to better living; and an overview of aviation. This is soeial studies material and also natural science. It should prove of real practical value in teaching in these areas.

★

See the program of the Missouri State Science Teachers Association on page 27 of this journal. It may give you some ideas.

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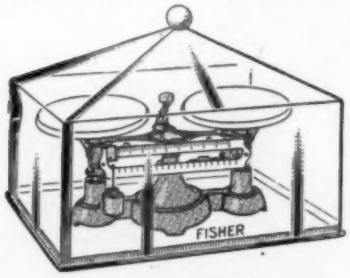

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Book Shelf

Continued from page 46

RADIO TROUBLESHOOTER'S HANDBOOK. Alfred A. Ghirardi. Radio and Technical Publishing Company, New York, 1943. Revised edition. 743 pp. $5.00, list.

The *Handbook*, revised and brought up to date, will be received with interest among amateurs and servicemen among whom the earlier editions were well known. Almost every data chart and table is now prefaced with a concise text which explains the nature and purpose of the data, together with instruction and actual typical examples for its correct use. The "Case Histories" section, to which about half of the volume is devoted, is brought up to date. Its data is based on actual extensive servicing experience with almost four thousand models of receivers and record players.

J. S.

ATOMS, STARS AND NEBULAE. Goldberg and Aller. Blakiston Company, Philadelphia, 1943. 323 pp. $2.50, list.

Many an amateur and layman will be delighted with this, the latest addition to the Harvard series on astronomy. In his exploration of stellar bodies, the reader digs into the very atoms. He encounters single stars, multiple stars, dwarf stars and giant stars, cool stars and hot stars, stars that pulsate and occasionally some involved in cataclysmic stellar explosions. There is an interesting estimation of what the future will be like if our notions of the interior of stars are not too greatly in error.

J. S.

YOUTH CONSIDERS THE HEAVENS. Elsa Marie Meder, Research Associate, Bureau of Educational Research in Science, Teachers College, Columbia University. King's Crown Press, New York, 1942. 60 pp. $1.00.

In *Youth Considers the Heavens* the opinions of high school students as to man's place in the world in relation to their astronomical information. It will be of interest to high school teachers and also will be of value to those concerned with techniques of identifying changes of opinion, for in it a method of preparing objective opinion tests is carefully described. ★

A good teacher forces children to answer their questions in many instances. For example, suppose that a child asks the meaning of a word. A good teacher points to the dictionary instead of telling the meaning.

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